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Snake Forms in the Constellations

And on Babylonian Boundary Stones.

By E. WALTER MAUNDER, F.R.A.S.

AMONGST the spoil brought by various explorers from Babylonia are a number of small sculptured stones, commonly known as boundary stones or landmarks. These are inscribed with texts in archaic Babylonian and Assyrian characters, and record the transfer of lands and estates, or grants and renewal of grants. But besides the inscriptions, most of them carry a number of figures sculptured in low relief. Some of these are certainly astronomical; others are probably so. There can be no mistake about such a figure as is seen in the middle of the second row of the stone shown in the accompanying photograph (see Fig. 1). The slab in question was one found at Susa, whither it had been taken from Babylonia, and contains the record of a land grant by Melishikhu, King of Babylon, B.C. 1200. The stone itself is in the Museum of the Louvre. The figure shows a "capricorn"—that is, a goat with the tail of a fish. On another stone, a representation of Sagittarius has been found, in which not only is the composite figure shown of the archer—half-man, half-horse, drawing his bow to the head of the arrow—but the archer has a wing, stretched back exactly like the flying cloak seen in the designs of our star atlases to-day. About composite figures of this definiteness there can be no mistake; they are obviously constellational in origin.

The case is a little different with such forms as the scorpion, the bull, the dog, or the eagle, since these forms are not specialised in the constellations; but their occurrence in such close connection with symbols manifestly stellar, renders it probable that they are of the same character. The argument with respect to the scorpion—a form continually seen—is stronger. Not only is the attitude of the scorpion always precisely that of the zodiacal animal, but a very fine boundary stone of the reign of Nebuchadnezzar I., King of Babylon, date about B.C. 1120, shows, as well as a scorpion, a vigorous composite figure which appears to have been formed by combining the symbols of the three neighbouring constellations, Aquila, Sagittarius, and Scorpio.

It is not surprising that the serpent should be conspicuous amongst these sculptured forms; it figures so largely in pagan mythology that its absence would be more surprising than its presence. Yet here the positions assigned to the various serpent forms are peculiar, and seem to me to bear a manifest relation to the positions occupied by the various snakes and dragons of the celestial sphere.

So far as I know, although it has often been noted that Draco is coiled symmetrically about the pole

Fig. 1.—Boundary-stone in the Louvre. Approximate date, B.C. 1200.
(From a Photograph by Messrs. W. A. Mansell.)

of the ecliptic, no astronomer has ever called attention to the very remarkable positions occupied by two great constellations, Hydra and Serpens in the primitive sphere. The reason of the oversight has been simply that astronomers have been led astray as to the date of the origin of the constellations by preconceived notions, and have entirely neglected the evidence which the stellar figures themselves supplied of their antiquity and place of origin. As I have had occasion to point out in this magazine before, the area in the southern heavens left untouched by any of the constellations handed down to us by Aratus, is clear proof that the

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work of primitive constellation-making was carried out on an organised plan, and came to a conclusion at a definite epoch. The date of that conclusion was, roughly speaking, 2700 or 2800 B.C.; the place somewhere not far from N. Lat. 40°. For there, and there only, did the portion of the heavens covered by the traditional figures correspond precisely to that rising at some time or other in the year above the horizon of the place.

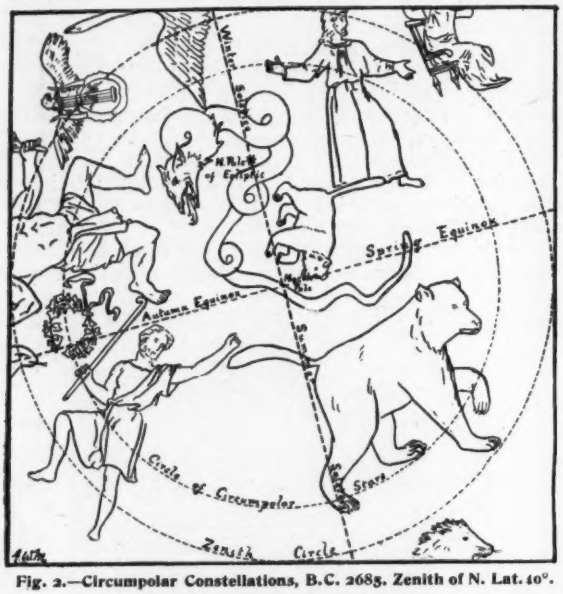

Fig. 2.—Circumpolar Constellations, B.C. 2685. Zenith of N. Lat. 40°.

If we take a precessional globe, move the pole back some 64° or 65° of precession, corresponding, say, to about 2700 B.C., and adjust the globe for N. Lat. 40°—in other words, set it to the time and place when the constellation figures were first defined—what do we find? First of all the Great Dragon (see Fig. 2) clearly is arranged so as to link together the north pole of the heavens and the north pole of the ecliptic. It is as nearly as possible symmetrical with regard to the two; it occupies the very crown of the heavens. With the single exception of the Lesser Bear which it almost surrounds, Draco is the only constellation that never sets.

Next Hydra. Here we have an arrangement even more striking. As Fig. 3 will show, Hydra at this time lay right along the equator, extending over about 105°, or seven hours of Right Ascension. Thirdly, Serpens. As Fig. 4 will show, the snake carried by Ophiuchus not only writhes itself for some distance along the equator, but struggles upwards, straight along the autumnal colure, reaching and marking the zenith by its head. It is scarcely conceivable that this threefold arrangement, which is not suggested by any natural grouping of the stars, should have been carried out as a matter of pure accident. It must have been intentional. For some reason or other—possibly for the simple one that a snake was the animal form that best lent itself to such a purpose—the equator, the colure, the zenith, and the poles were all marked out by these serpentine or draconic forms. Possibly in this striking but unmistakable relation we may find an explanation of the old myth that a total eclipse of either sun or moon was caused by a dragon; of the adoption of the Dragon's Tail as the sign of the nodes of the moon's orbit with the ecliptic; and of the term "draconic" or "draconitic" month for the period taken by the moon to pass from the ascending node round to the ascending node again. It may be noted that in Fig. 1 in the second row of figures, just succeeding the capricorn, there is a little house or altar surmounted by a symbol identical in form with the Dragon's Tail symbol, which we use to-day for the descending node.

But now let us turn to the boundary stones and see where and how the serpents are presented to us there. In Fig. 5, which is a photograph of No. 90,829 in the British Museum, and shows another boundary stone of The reign of Melishikhu, the dragon is seen on the very top of the stone, coiled in an attitude much like that of Draco of the sphere. In Fig. 1, we find the snake stretched out straight at the base of the stone like Hydra along the equator. In Fig. 6 (No. 90,840 in the British Museum), we have the snake bent sharply at right angles, lying partly, therefore, at the base of the sculptures, and partly up the side, in an attitude recalling that of Serpens along the equator and up the colure. The snake in Fig. 7 (No. 90,835 in the British Museum, of presumed date about 1100 B.C.), rises straight up the stone, and it is not certain whether we should identify it with Hydra or with Serpens. But the positions of the snakes or dragons in the first three instances are sufficiently striking as to suggest that some 1,500 years after the original designing of the constellations, and when both colure and equator had moved from their primitive positions, the tradition of the original purpose of these serpentine figures still remained.

There are three symbols, very clearly seen on the

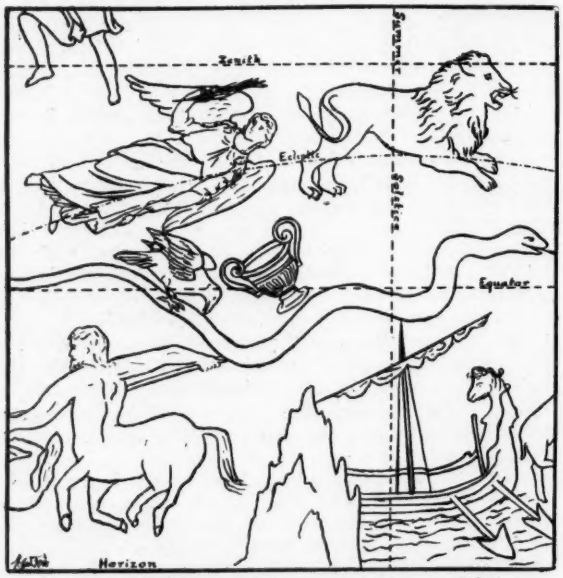

Fig. 3.—Equatorial Constellations, near the Summer Solstice, B.C. 2685. Zenith of N. Lat. 40°.

boundary stone from the Louvre (Fig. 1), and on the actual stone No. 90,840, though partly hidden on the photograph through the effect of foreshortening, which are of very considerable interest. They are present, though less distinctly seen, on the other two stones; indeed, with but one or two exceptions they are a feature of all stones of the class. These are a crescent moon "on its back," and two stars, usually of different forms. The first is an eight-rayed star, the second a

circle containing a four-rayed star. These we know, from actual inscriptions on some stones of the kind, to be the symbols of the patron deities of the first two months of the year; the first month being presided over by the moon-god, the second by a pair of deities, the "Heavenly Twins."

There is a special significance in both these symbols. The Accadian and Assyrian years were luni-solar, the months being actual lunations, and twelve months constituting a normal year. But since twelve months are eleven days short of a solar year, a thirteenth month must be intercalated about every third year, or the beginning of the year will quickly travel backwards amongst the seasons. The Mahomedan year, which consists of twelve lunar months, does this, and its fasts and feasts bear no relation to the seasons. But the Accadians evidently wished their year to conform as closely as possible to the solar year, and the method which they employed to secure this result was both simple and efficient. The first new moon of the year was recognised by the presence near it in the evening sky of a bright star, unquestionably at one time the star Capella. It might happen that on the first evening, when the thin crescent was perceived, it would be close to Capella, and the two objects would set together. Twelve lunar months later the new moon would be observed again, but these twelve months being eleven days short of a complete solar year the moon would be some 11° less advanced in longitude than it was on the former occasion. But since the moon's daily motion in longitude is about 13°, the moon and Capella would set nearly together on the following evening—the second evening of the month.

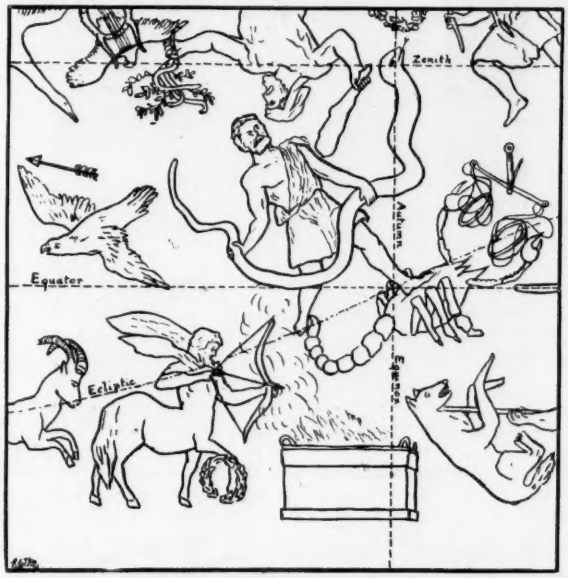

Fig. 4.—Equatorial Constellations, near the Autumn Equinox, B.C. 2685. Zenith of N. Lat. 40

At the end of another twelve months it would not be until the third evening of the month that Capella and the moon set together, and in a fourth year it would probably be on the fourth evening. But this, again, would involve that the two objects would set together on the first evening of the following month, which would, therefore, be the true first month of the year. In other words, the third year, that is to say, any year indicated by the setting together of the moon and Capella on the third evening of the month, would be a year thirteen months in length; other years would be of twelve months.

If Capella were observed setting with the moon at the beginning of the first month, would there be any bright star seen with it at the beginning of the second month? There would be two—Castor and Pollux—which would serve, should the evenings of the first month have been cloudy, to furnish just the same

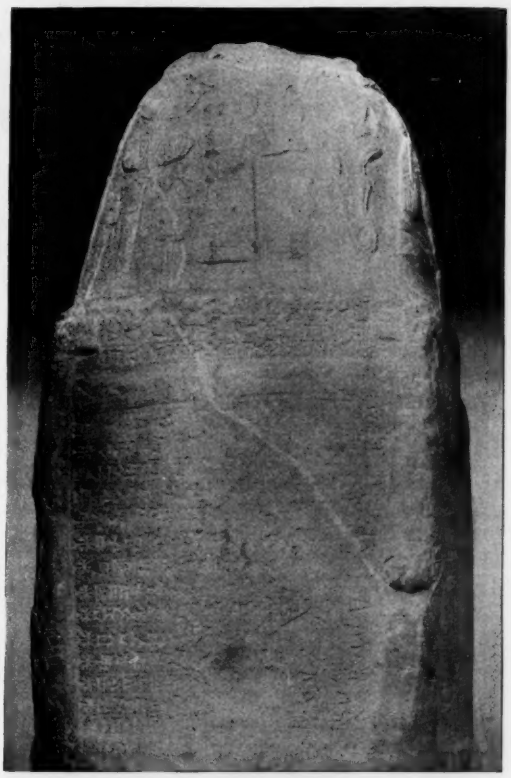

Fig. 5.—Boundary-stone, No. 90,829, in the British Museum. Date, about 1200 B.C.
(From a Photograph by Messrs. W. A. Mansell.)

indication as to whether the year would be an ordinary one or an intercalary one, that Capella had given in the first month. There are no bright stars suitably placed to continue these indications for the succeeding months of the year.

This method by which the new moon was practically used as a pointer for determining the return of the sun to a definite constellation at the end of the solar year, is utterly unlike the methods which writers have supposed the ancient astronomers were accustomed to use. But we know from an existing inscription, that it was actually employed; it was eminently simple; it required no instruments or star maps; it may have been in use long before the constellations were mapped out; and though rough, it was perfectly efficient, and would give the mean length of the year with all the accuracy that was then required. It had one drawback, which the ancients could not have been expected to foresee. The effect of precession would be to throw the beginning of the year gradually later and later—roughly speaking, by a day in every seventy years, and the time no doubt came when it was noticed that the seasons no longer bore their traditional relation to the

months of the year. With Capella, as the star of the first month, the year would commence, on the average, with the spring equinox about 2000 B.C.; if Castor and Pollux were originally used for the first month of the year then the corresponding date would be 4000 B.C.

Now we can see the significance of this threefold symbol, so often seen on votive slabs and boundary stones—the moon "on its back" together with two stars. It is simply a picture of the sunset sky of the first evening of the first month of the year, some 6,000 years ago. The crescent is shown on her back, because then, on the first evening of the month nearest the spring equinox, she is more nearly in that attitude than at any other time throughout the year.

Fig. 6.—Boundary-stone, No. 90,840, in the British Museum. Date, about 1100 B.C.
(From a Photograph by Messrs. W. A. Mansell.)

I would suggest that these three figures, the simple representation of what all the primitive observers saw year after year through many centuries in the evening sky at the beginning of the first month, were handed down through long tradition as emphatically the symbols of the year; but that in process of time a certain change took place in the precise significance attached to them. At some time between 4000 B.C. and 2000 B.C., men must have recognised that the beginning of the year was falling too late. The obvious remedy would be to shift that beginning by a single month, where Capella would be ready precisely in the right position to act as index star. Whilst Capella was fulfilling this office it is probable that a separation was made in the three symbols. The crescent "on its back" would be still the appropriate sign for the first month of the year, but Castor and Pollux would now indicate the second. When the months were assigned to various deities the moon-god inevitably presided over the month of which the sign was the crescent; and the deities of the two great lights, Tammuz and Istar, would as naturally be associated with the pair of stars. Later still, Istar may have been identified rather with the planet Venus than with the moon, since the latter was already symbolised in the first month, so that Signor Schiaparelli's explanation of the three signs may hold quite good for latter times. That it did not hold good in earlier times we may infer from the well-known triumphal stele of Naram Sin, in which the twin stars are shown exactly similar in design, which could hardly have been the case if at that time they represented objects so dissimilar as the sun and the planet Venus.

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BOUNDARY STONE
INSCRIBED WITH A SERIES OF TEXTS
REFERRING TO THE OWNERSHIP OF
A CERTAIN ESTATE DURING THE REIGNS
OF NABÛ-UKÎN-APLI AND NINIB-KUDUR-USUR,
KINGS OF BABYLON, ABOUT B.C. 1000.

Fig. 7.—Boundary-stone in the British Museum.
(From a Photograph by Messrs. W. A. Mansell.)

[The photographs of boundary stones from the Louvre and the British Museum are reproduced by the kind permission of Messrs. W. A. Mansell, of 405, Oxford Street, by whom they were taken].

III.—The Influence of Fungi

For Bad on Other Forms of Life.

By George Massee, F.L.S.

Fungi are looked upon with a certain amount of justifiable suspicion by the majority of people, on account of their poisonous properties. Some kinds are undoubtedly very poisonous, but the dangers attendant on eating fungi have been much exaggerated. The percentage of edible fungi, compared with the whole number, excluding the microscopic forms, is much greater than in the flowering plants.

A very considerable number of the cases of fungus poisoning recorded annually are in reality not due to having eaten poisonous fungi, and may be explained as follows. In the country, when fungi are abundant, they are frequently not used sparingly, in the sense of a relish, but often constitute the greater portion, if not the only dish for a hearty meal. If a meal of this nature is accompanied or followed by the drinking of alcoholic liquor, more especially spirits, the fungi eaten coagulate and form an indigestible mass, which to say the least causes much discomfort, and may become serious. Strong tea acts in a similar manner to alcohol. An oyster supper followed by a copious supply of whisky would in most instances produce similar unpleasant results.

Nevertheless all such instances are recorded as cases of poisoning by fungi.

This is not the place to enter into an explanation of the differences between edible and poisonous fungi; it is, however, necessary to state that the old fables on the subject, such as the separable skin of the cap, or the blackening of a silver spoon when brought into contact with the cooked fungus, are absolutely unreliable.

Above ninety per cent. of the cases of poisoning by fungi, both in Europe and North America, is due to partaking of one particular kind of fungus called the "Death cup" (*Agaricus phalloides*). The popular name is derived from the presence of a loose cup-like sheath surrounding the base of the stem.

The presence of a cup at the base of the stem is not, however, the hall-mark of all poisonous fungi; in fact, some among the best known of edible fungi have a similar cup, and it is the sum-total of characters presented by the "Death cup" that enables it to be recognised with certainty.

The "Death cup" is very abundant in woods in this country, but does not grow in open pastures like the common mushroom. When full-grown, the cap is slightly convex, smooth, and usually of a very pale primrose colour; the gills remain permanently white; the stem is from four to five inches in length, white, and bearing a loose white collar some little distance from the top; the base is surrounded by a loose cup-like sheath having a ragged edge.

Lack of space forbids entering into a detailed account of the numerous diseases caused to members of the animal kingdom by fungi—"Thrush" (*Oidium albicans*), appearing in the mouths of infants; "ring-worm" (*Achorion Schoenlenii*), a disease which passes from man to animals; "Muscardine" (*Botrytis bassiana*) proves very destructive to silkworms. Mention has already been made of the diseases of other insects caused by fungi.

In speaking of fungi beneficial to other forms of life, it was stated that we benefited to the extent of hundreds of millions of pounds sterling annually through work done by fungi. On the other hand, it is equally true that we annually lose at least an equal amount, due to the injury caused by parasitic fungi. In support of this statement, which, perhaps, might be considered as improbable, it may be well to give some official statements. The Prussian Statistics Bureau announced a loss of £20,628,147 on wheat,

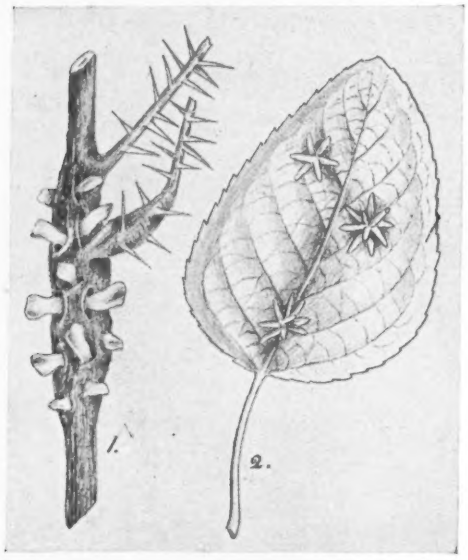
The "Death-cup" Fungus (*Agaricus phalloides*). **Natural size.**

rye, and oats grown in Prussia, caused by grain rust during the year 1891. Wheat rust caused a loss of £2,500,000 on the wheat harvest of 1890-91 in Australia. In the year-book of the United States Department of Agriculture for 1898 the loss of cultivated crops caused by fungi for that year is estimated at £40,000,000. A fungus disease called peach leaf-curl, which proves very destructive to peach trees, does injury to the extent of £600,000 annually in the United States. No official statements as to the amount of injury done by fungi to cultivated crops are issued in this country, but it is quite certain that we suffer as much in this respect as other countries. English cucumber growers suffered a loss of at least £20,000 during the year 1901, caused by the ravages of a microscopic fungus parasite.

The question naturally suggested by the above statements is, Can nothing be done to prevent, or at least to reduce, such enormous losses? In answer it may be

stated that at the present day provisions are made in almost every civilised country for studying fungus diseases, and for imparting practical information on the subject to farmers and horticulturists. In this country the Board of Agriculture is the headquarters in this matter, aided by various colleges and societies.

Symbiosis or mutualism are terms expressing a condition of things where parasite and host mutually benefit by their union. Lichens are the most pronounced examples of this condition of things, and even here the combination retains many of the characteristics of a more pronounced type of parasitism, where the plant attacked suffers from every point of view without any compensating factor. For instance, the algal and fungal constituents of a lichen each loses its own individuality, and is incapable of performing those functions which are natural to it as a free and independent entity.



The Hawthorn Cluster-cup Fungus. (1) The first condition parasitic on a Juniper branch (natural size); (2) the second condition growing on a living pear leaf (natural size).

In many other instances where a parasitic fungus attacks a particular host plant, the latter is not killed, but on the other hand the part attacked, which is often sharply localised and modified, continues to grow from year to year. This is very clearly seen in the dense tufts of branches popularly known as "witches' brooms" or "birds' nests," so common on many of our forest and fruit trees.

Such developments, which are frequently of large size and very conspicuous, present marked differences in structure and habit to the normal portion of the tree on which they are growing. For instance, the branches of "witches' brooms" always grow erect, the leaves are feebly developed and almost destitute of chlorophyll, and are hence incapable of assimilating food; finally, such portions never bear flowers. Now, from the above statement, it will have been gathered that such combinations of fungus and host plant are incapable of furnishing themselves with food, and in reality lead in turn a parasitic life on the normal part of the tree of which they form a portion.

It may, perhaps, be well to state that not every "bird's nest" seen in trees is caused by a fungus. For example, the dense tufts so common in many birch trees are caused by a very minute mite.

Allusion has already been made to the fact that many fungi assume a very different appearance both in form, size, and colour, during different periods of their development. These contrasts are in many instances so pronounced that the various phases of one and the same fungus were at one time considered as entities or distinct species, and allotted positions in the classification of fungi widely separated from each other.

Loose smut of oats, *Ustilago avenæ*. (1) Ear of oats infected (natural size); (2) spores of the fungus highly magnified); (3) spores germinating and producing minute secondary spores (highly magnified).

Our knowledge at the present day that certain forms are but links in the chain of one species depends on what are termed pure cultures. This means that one form or condition of a fungus, grown under conditions which prevent the possibility of contamination from outside sources, eventually produces the second condition; while this, in turn, again gives origin to the first condition.

As an illustration of a fungus appearing under two remarkably different forms, and growing on different plants during certain stages of its life-cycle, may be mentioned the destructive parasite popularly known as hawthorn cluster-cups. The first or spring condition, called *Gymnosporangium clavariaforme*, grows on the common juniper tree, where it causes the infected branches to assume a swollen or gouty appearance. During the month of May these swollen portions become covered with dull orange-coloured, gelatinous, finger-like bodies about half an inch long. When examined under the microscope, these orange gelatinous masses are seen to consist entirely of a mass of

spores, each spore being divided by a cross-wall into two equal portions, and supported on a very long slender stalk. The mycelium of this condition of the fungus is perennial; that is, it remains living in the infected juniper branch from year to year; consequently, when a branch is once infected, the disease continues to spread, the swelling continues to increase in size, and a crop of spores is formed every spring. If the orange masses of spores are carefully observed they will be seen eventually to become covered with a delicate whitish bloom, resembling in appearance the bloom on a plum or a grape. Examination under the microscope shows that this apparent bloom consists in reality of a mass of exceedingly minute spores, or, as they are usually called, secondary-spores, produced by the much larger previously formed orange spores.

These secondary-spores, which are produced in enormous quantities, become free when mature, and are distributed by wind, birds, insects, &c., and those that happen to alight on the moist surface of young leaves of pear trees, or on the young shoots, leaves, or fruit of the hawthorn, germinate and enter the tissues of the living plant, and in course of time produce the second form of fruit, at one time considered as an independent fungus, and called *Roestelia*. The spores of this form are in turn dispersed by wind, &c., and those that alight on a juniper branch give origin eventually to the form of fruit found only on juniper.

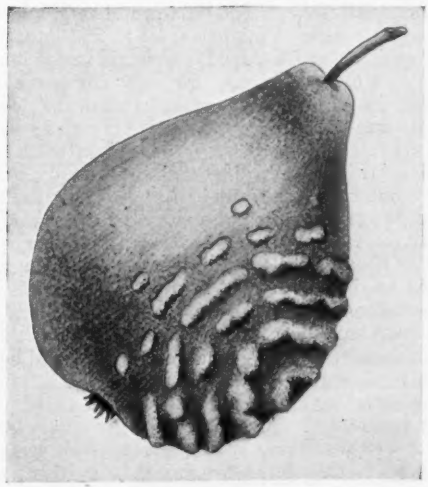
The feature to remember in the above account is the fact that the spores produced by the form of the fungus growing on juniper cannot directly infect a juniper again, but can only infect pear or hawthorn; on the other hand the spores produced on pear or hawthorn cannot directly infect either of these plants, but only a juniper plant. The spores cannot infect any other plant except the three mentioned.

The very injurious rust of wheat, *Puccinia graminis*, which abounds wherever this cereal is cultivated, is a fungus having four different forms or phases included in its life-cycle. Two of these appear in the spring on the young leaves of the common barberry, and less frequently also on the fruit of this shrub. The first condition to appear on the leaves, under the form of minute, inconspicuous yellowish clusters of pimples, are the spermogonia, structures of unknown functions, and by some considered as aborted male organs. These are quickly followed on the opposite side of the leaf by clusters of minute, cup-shaped bodies with notched edges, and filled with myriads of very minute golden spores. The last mentioned stage of the fungus was once considered to be an independent plant, and was named *Aecidium berberidis*. It is popularly known as "cluster-cups," and is a very beautiful object when examined with a pocket-lens, or under a low power of the microscope. The spores produced in the cups are scattered by wind or carried by various insects or animals, and those that happen to alight on the young leaves of wheat soon germinate and enter the tissues of the wheat leaf, and after the space of a few days rusty-orange streaks appear bursting through to the surface of the leaf. These rusty streaks consist of masses of spores belonging to the third condition of the fungus, once called *Uredo linearis*. The spores of this form are produced in immense numbers and in rapid succession throughout the summer months, and, being scattered by the various agents enumerated above, it can be readily understood how quickly an epidemic of rust can spread when a few wheat plants in a field have once been infected.

During the autumn when the wheat is approaching maturity, the development of *Uredo* spores ceases, and a fourth form of spore, the last in the sequence of development, appears on the leaves of the wheat plant. This is the *Puccinia* stage. These spores remain in a dormant condition until the following spring, when they germinate and produce very minute secondary-spores which, when placed on a barberry leaf, give origin again to the spermogonia and "cluster-cup" conditions, and the cycle of development commences anew.

The "Smuts" and "Bunts" are also very destructive to cereals, forming a dense mass of black soot-like spores in the ears. Some species infesting wheat have a very unpleasant odour resembling decaying fish when rubbed between the fingers. The life-history of the Smuts (*Ustilago*) is peculiar.

The minute black spores are scattered by wind, and remain in the soil until the following spring, when they germinate, and the germ-tubes enter the tissues



The conidial or first stage of a fungus called *Sclerotinia fructigena*, very common on the fruit of the apple, pear, plum, cherry, &c. It causes the fruit to become dry and "mummified" (natural size).

of seedling cereals. The fungus grows in the tissues of the host-plant without doing any apparent injury until the ear is formed, when the fungus develops in the position normally occupied by the grain, and in due time its mass of black, powdery spores bursts through the tissues of its host-plant. In all cereals except maize the fungus can only infect the plant during the seedling stage. When a month old the fungus mycelium can no longer enter the tissues. Space prevents more than a passing allusion to the numerous diseases caused by fungi to forest and fruit trees. Larch trees, especially when grown in low damp districts, suffer severely from a small and very beautiful cup-shaped fungus, orange inside, snow-white and minutely woolly on the outside. Fruit trees, more especially apple, are too often killed by a fungus which destroys the bark and produces a cankered appearance, finally killing the branch attacked.

Neither are fruits exempt, the numerous blotches and rotten patches on ripe fruit being in most instances attributable to fungi.

XUM

Astronomy in the Old Testament.

By Miss M. A. Orr.

The Jews were forbidden to study and forecast the movements of the heavenly bodies, lest they should be led away into star worship and star divination. So says the Talmud. Yet some knowledge of astronomy is necessary to a nation, and especially to her priests; for only by observation of the heavenly bodies can the dates of festivals be accurately fixed. How far did this knowledge extend with the Jews?

Professor Schiaparelli, who has written learnedly and sympathetically on ancient Greek astronomy, now essays to answer this question, by studying the text of the Old Testament, and comparing it with the best translations and commentaries.* The data are scanty, and unfortunately just where we might expect to find light—namely in the ancient Jewish calendar—we are in the dark. The month was evidently lunar, from its Hebrew name, and from the frequent mention of festivals of the new moon; the year was as clearly solar, since the three great yearly religious festivals were all connected with the seasons. But a solar year does not contain a whole number of lunar months, and the problem of bringing the two into accord has taxed the skill, and tested the knowledge, of primitive astronomers of all nations. We cannot be sure how the Jews solved the problem. They counted twelve months in their year, and no mention is made of extra days or intercalated months. Some such device, however, there must have been. Some writers assume that astronomical observations were made, which would have been the only exact guide. Professor Schiaparelli thinks, with some others, that a thirteenth month was added whenever it was apparent that the crops would not otherwise be ripe in time for the offering of first-fruits, which was made on the fifteenth day of the 1st month. In this way direct terrestrial observations of the seasons would be used to correct a calendar founded on celestial phenomena. The Jubilee period of 49 solar years is almost exactly equal to 606 lunations, and this would have given a useful cycle; but there is no reason to think that it was used for this purpose.

In connection with the custom of reckoning the day from evening to evening, derived perhaps from the method of beginning the month with the first appearance of the crescent moon, Schiaparelli suggests an explanation of the curious phrase "between the two evenings." (See marginal translation at Exodus xii. 6 and xxx. 8.) The evening, he says, was divided into two parts, the first beginning at sunset when it was still light enough to work, the second at the moment when a crescent moon would be visible, and ending when it had become quite dark and all stars were visible. The second evening would begin, on an average, half an hour after sunset, and an hour before dark. This was the beginning of the new day, and it was then that Aaron lighted the lamps and burned incense.

How were night and day divided? There is no word for hour in Hebrew, but only in the dialects which took its place in Palestine after the Exile. The word in the book of Daniel is Aramaic, and the expression "that same hour" means merely "immediately." Much has been written about the so-called dial of Ahaz. The fact is, as Schiaparelli points out, that the word which in our Authorised Version is given first as "degrees" and then as "sun-dial" is in the Hebrew the same, and means literally "steps." A glance at the marginal notes will show that the rendering is a hypothesis of the translators. Hezekiah, living about 700 B.C., may have possessed a sun-dial, brought from Babylon or elsewhere, but there is no internal evidence to prove that he had; and it seems quite as likely that the passage: "Behold, I will bring again the shadow on the steps, which is gone down on the steps of Ahaz, ten steps backward" refers to a flight of palace steps which the sick king could see from his bed, and that he marked the lapse of time by the creeping of the shadow from step to step. If dials were used, there would surely be some mention of divisions of the day more exact than "in the heat of the day," "early in the morning," &c.

The Hebrew week, with its seventh sacred day, Schiaparelli thinks had no connection with the Babylonian unlucky seventh day, since that was bound up with the lunar month, while the former was an independent period.

A few stars and constellations are mentioned in the Old Testament, but it is sometimes difficult to know which are meant. Most commentators agree that the Kesil and Kimah of Job and Amos are Orion and the Pleiades, but there is a curious passage in Isaiah: "The stars of heaven and the Orions (Kesilim) thereof," which the Authorised Version renders "the constellations thereof," and the Vulgate "the glory of them." Probably Orion is here put for any constellation, being bright and well known. "The sweet influences of the Pleiades" is a free rendering of a puzzling expression. No one knows what was really meant by the "chains" or "delights" of the Pleiades, for the literal meaning is one of these. Some have thought it an allusion to the time of year in which the Pleiades were visible; Maury saw in it a reference to Alcyone as the central sun of the universe! To the present writer it seems that in this passage Job is challenged to form or break up the constellations which had been set in heaven by an immutable Divine decree: "Canst thou bind the Pleiades into a cluster, or scatter apart the stars of Orion?"

The Authorised Version translation of Arcturus in the eighth and thirty-eighth chapters of Job is open to question. It is more often thought to be Ursa Major; but Professor Schiaparelli gives weighty reasons, too many to detail here, for believing it to be Aldebaran, and the "sons of Aldebaran" the Hyades.

Less convincing, but ingenious, is the suggested explanation of Job xxxvii., 9: "Out of the Inner Chambers comes the south wind, from Mezarim the cold." "The Chambers of the South" are also mentioned in the ninth chapter of Job among constellations, and Professor Schiaparelli thinks that they were a Jewish constellation, containing the brilliant stars of Argo and Centaur, the inner chambers (= penetralia) of a house being where jewels and precious things are kept. Mezarim should be a northern constellation to complete the antithesis; correct the reading to Mizrajim, the Threshing Flails, and this aptly describes the forms of Ursa Major and Minor. The Septuagint translates Mezarim as Arcturus, but means (says Grotius) Arctos—*i.e.*, Ursa Major. So old, then is Shelley's mistake:—

"Daisies, those pearled Arcturi of the earth,
"The constellated flower that never sets."

* "L'Astronomia nell' Antico Testamento," G. Schiaparelli. (Milan: Hoepli.)

Of the planets, there can be little doubt that Venus is named in the splendid apostrophe: "How art thou fallen from heaven, O Helêl, Son of the morning!" It has been thought that Venus and Jupiter were meant by the Gad and Meni ("that troop" and "that number") of Isaiah lxv., 2, but this is doubtful. If Kaivan, rather than Chiun, is the correct reading of Amos v., 26, Saturn is here intended, for that was his name among the ancient Arabs and Syrians. The passage would read: "Ye have taken Sakkuth your king, and Saturn, the star of your God, images which ye have made for yourselves."

The only other name in the Bible which is certainly connected with stars is that of Mazzaroth. "Canst thou bring forth Mazzaroth in his season?" is asked of Job, immediately after the mention of Orion and the Pleiades quoted above. A name so nearly alike that it can hardly fail to be the same thing occurs in one other place. In the reform of Josiah, the burning of incense to "Baal, to the Sun, and to the Moon, and to Mazzaloth, and to all the host of heaven," was abolished. For etymological and other reasons, Mazzaroth, or Mazzaloth, has been variously translated as Lucifer, Sirius, Ursa Major, the northern stars generally, Corona Borealis, Orion's belt, the constellations of the Zodiac, the stations of the Moon, the planets. Professor Schiaparelli, without venturing to decide absolutely, favours the first, chiefly for the following reasons:—

(1) A plural noun is used with a singular pronoun, suggesting the dual nature of Venus as morning and evening star.

(2) "In his season" indicates a periodical appearance and disappearance.

(3) The position of the name in the sentence, coming after Sun and Moon, but before all the host of heaven, suggests a star inferior only to Sun and Moon in brightness.

We may, however, be permitted to suggest that Mazzaroth was perhaps superior to the host of heaven in importance, not in brightness; and, if so, this argument, as well as the two others, would apply equally well to the constellations of the Zodiac. They are plural, though the Zodiac is singular; and their chief feature is periodical re-appearance.

But Professor Schiaparelli reminds us also of the three constantly recurring symbols on Babylonian monuments, which we know represent Sin, Samas, and Istar—that is, Sun, Moon, and Venus. The "host of heaven," when it means something more than simply the stars in general, he regards as all the planetary and starry deities of the Babylonian Pantheon, the "spirits of heaven."

The attempt to formulate a Hebrew cosmogony does not appear to us altogether successful. It is difficult to accept the view that, because Job speaks poetically of the sky as "strong, and as a molten looking-glass," while in a Psalm it is likened to a curtain, therefore the Hebrews recognised two heavens, one above the other, the higher containing the stars; nor does it seem like serious criticism to try to locate the "treasuries" of hail, snow, and wind.

The truth is that the ancient Hebrews felt no intellectual need, as did the Greeks, to construct world schemes in order to explain natural phenomena. The universe was to them, as Professor Schiaparelli himself observes, simply the marvellous and inscrutable manifestation of one supreme Power. It will doubtless be a surprise to some to find that a whole book can be filled with the astronomy of the Old Testament.

Photography.

Pure and Applied.

By Chapman Jones, F.I.C., F.C.S., &c.

Measuring Apparatus.—Photographic operations and apparatus for their investigation are far from perfect from a scientific point of view. There are no instruments, so far, even if there are methods, that can fitly be described as "standard," so that every investigator who seriously devotes himself to the subject has first to examine experimental methods and then, generally, to design the apparatus that he considers will prove most suitable. There are a few fundamental matters that too often do not receive the consideration that they demand by reason of the general want of experience. It is obvious that in all experimental methods it is waste of trouble to eliminate a very small error while a large error remains. It is very difficult to enforce this principle even in the most obvious cases, as, for example, in the common case of weighing a measured quantity of liquid. Here, if the smallest difference in measurement is equal to a drop (say ·02 gram), it is useless to refine the method of weighing beyond about a tenth of its weight (say ·002). One may admit the correctness of this principle, and yet easily fall into the error of neglecting it, especially when the larger source of error is not particularly obvious. It is sometimes easier to see the mote than the beam. It seems to me possible that Messrs. C. E. K. Mees and S. E. Sheppard have made this kind of mistake in designing the apparatus described in the next paragraph, and this suggestion receives a certain amount of confirmation by the fact that they refer to my opacity meter as an opacity balance, and to the opacity balance that I subsequently described as an "improved form" of the earlier instrument. Neither of these two instruments is an improved form of the other, they are distinct instruments. The *meter* measures the opacity by comparing the light that it transmits with the original light, and the measurement is absolute in the sense that the estimation depends only on the correct adjustment of the meter, the observer's experimental ability, and the opacity measured. The *balance* cannot do this at all. It merely serves to compare similar opacities on the same plate, as, for example, in evaluating the results of an experiment by means of a light-scale of known value produced on the same plate. The meter, of course, can do this also, but the balance serves this one purpose better, being more convenient and more accurate for it than the meter. The balance will not even serve to estimate opacities by comparing them with a standard opacity scale, such as the circular graduated screen (incorrectly called a sensitometer) first produced by Mr. Warnerke and now made by Messrs. Sanger Shepherd and Co., because in the opacity balance the light transmitted that is scattered is lost. The proportion of this scattered light is very large, and I have shown it to vary between wide limits according to the nature of the deposit in the film, and to vary even in different opacities in the same plate.

The Apparatus used by Messrs. Mees and Sheppard.—In the current number (July) of the *Journal of the Royal Photographic Society*, Messrs. C. E. K. Mees and S. E. Sheppard describe the apparatus they use in their photographic investigations, and which they intend for use in "scientific photochemical research and plate-making and testing." A machine for coating small quantities of plates for experimental purposes has a

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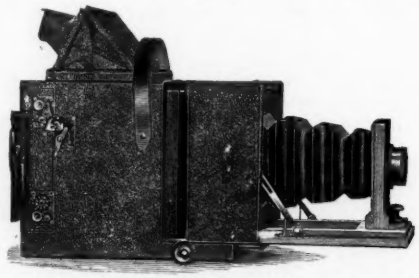
bed of plate glass supported on levelling screws, along which is drawn at constant speed a piece of glass covered with velvet on its under side and carrying the plates to be coated. The trough that holds the emulsion is made of platinoid, it is surrounded with a large hot-water bath, and to pass the emulsion to the plates it has a slit below, that is made with great accuracy and adjustable like a spectroscope slit. The trough is 7 c.m. high and 1 c.m. wide. I should have thought that the alteration in level of the other emulsion during the coating would have caused a variation in the thickness of the layer deposited, but there appears to be no mention of this. As a constant light, the authors employ a small area screened off from an acetylene flame. To graduate the light, a rotating disc with apertures in it of the ordinary kind is used, but it was made with special accuracy and calibrated before use. Much convenience and advantage results from enclosing the disc in a case with an opening and grooves on one side to take the slide that contains the plate, and a camera-like extension on the other containing a flap-shutter for starting and closing the exposure, cells for colour screens, and a diaphragm. It need not be used in a dark room. For developing the plates, which are one inch or an inch and a half wide, a thermostat containing about 10 gallons of water is used, with a stirrer, and a regulator of the ordinary Reichart type, the developer being contained in vertical glass tubes. During development the plates are rotated in the tubes, being suspended from vertical spindles for this purpose. The authors appear to find that this movement is better than a rocking movement with the plate horizontal, but still not perfect. I should have thought that this method would give a difference according to whether the end of the plate with the longest exposure was placed uppermost or otherwise, because at this end there must be the greatest change in the developer, and the vertical mixing effect produced by the regular rotation of the plate on a vertical axis in a tubular vessel must surely be very small. For measuring the opacities the authors use a Hüfner spectro-photometer, but with several modifications to fit it for this particular work. I may be mistaken, but I cannot find from the description that the difficulty of the scattered light is met in any way. It is easy to measure something, and with considerable accuracy, but if the something measured is indefinite the results cannot be very valuable. It is better to sacrifice a little accuracy if necessary for the sake of knowing exactly what is being dealt with. Perhaps the authors have taken more precautions than are obvious for their description. Regarding the apparatus as a whole, it appears to me that it presents many points of advantage that future workers will profit by, but I am convinced that there are many matters that need investigation before the results obtained in working with it can be accepted without qualification. I have sought only to give a general idea of the apparatus ; those interested will, of course, refer to the original paper.

A Naturalist's Camera.—The possibility of getting good typical photographs of living things has been amply demonstrated during the last few years, and many photographers have devoted themselves to this kind of work. That results of the first quality can be obtained with an ordinary camera when supplemented by home-made contrivances, has been shown by the brothers Kearton ; but the methods which they follow are possible for only a very few and appreciated by still fewer. Hence the demand for special facilities. One of the most recent cameras that has been devised to meet this demand is the " Birdland " camera designed by Mr. Oliver G. Pike and constructed by Messrs. Sanders and Crowhurst. It is a hand camera, for Mr. Pike's method of work is to follow the bird he wishes to photograph, focussing it meanwhile with one hand upon the full-size reflex finder, and to release the shutter with the other hand as soon as the bird is in the desired position. The well-known Anschutz focal plane shutter is made to form a part of the camera, and an especial part of the apparatus is the connection of this with the mirror of the finder so that when the release is actuated the mirror moves out of the way immediately before the opening in the blind passes across the plate. The whole movement follows so quickly on the touch of the trigger that there is no sensible interval, nor is there any jar or noticeable noise. The camera has many conveniences, the chief of which are a mirror in the finder hood, so that the image can be observed and focussed with the camera level with the eye, and the possibility of opening the front and drawing the lens forward, as shown in the figure, to allow of one combination of the doublet, or a lens of greater focal length, being used. The sensi-



tive material is carried in double backs, changing boxes, or roller slides. A camera of this kind is, of course, eminently suitable for almost any work in which a moving object has to be photographed at a critical moment, and that this particular instrument serves the purpose well is abundantly demonstrated by the photographs obtained by its aid by Mr. Pike himself and by Mr. F. Martin Duncan. A small selection of these is reproduced in the pamphlet describing the camera, which can be obtained on application to the makers.

The Scintilloscope.

One of the small defects of the cleverly-devised instruments for displaying the scintillations which are produced by the bombardment of radium is, that the speck of radium is placed on a tiny pointer, which is between the spectator's eye and the screen of pitchblende or other material that is bombarded. Consequently, the pointer partly obscures the effects.

In a little instrument sent to us, and called Glew's " Scintilloscope," the defect is remedied in an ingenious way. The instrument is in two parts, one part of which is the usual magnifying lens. The other part, detachable, is a double screen. The upper part of the screen is a thin plate of pitchblende polonium, or thorium, all of which are extremely sensitive to the impact of the "alpha" rays that proceed from a radio-active material. The lower or underneath part of the screen consists of a plate coated with some such material. The alpha rays strike upward, and produce scintillations of great brilliancy on the pitchblende or polonium above. The instrument is fitted with one, two, or three screens, and the difference in the effects produced is very interesting.

Sunspot Variation in Latitude.

By E. Walter Maunder, F.R.A.S.

In his letter, under the above title, in the August number of this journal Dr. Lockyer complains that Father Cortie and myself have misunderstood the meaning of the term "spot-activity track" which he has originated. I think this complaint has no justification in fact. Certainly, for myself, I did not suppose that he intended the term to apply to the proper motion of any individual spot, but it is abundantly clear that he did intend to intimate by it that the spots were gathered together in certain districts or regions, separated from each other by broad barren intervals, and that these districts, rich in spots, moved continuously downwards towards the equator; so that the entire "eleven-year period" was the summation of three, four, or five separate and distinct shorter cycles of activity. Dr. Lockyer himself applies the term "zone" to these districts; he has drawn them in his diagrams as distinct, widely separated, areas, each one moving continuously towards the equator; and his descriptions of them perfectly accord with his diagrams. He writes:—

> "From sunspot minimum to minimum there are three, but generally four distinct 'spot-activity tracks,' or loci of movements of the centres of action of spot disturbance." (*Proc. R. S.*, Vol. LXXIII., p. 147.)

Again:—

> "These 'spot-activity tracks' have possibly a terrestrial equivalent in the variations from year to year of the positions of the 'Zugstrassen' or cyclone tracks of Köppen, it having been found that cyclones in general, which move in the direction of the great mass of air carried by primary currents, have a strong tendency to pursue somewhat the same tracks according to the place of origin." (*Ibid*, p. 147.)

Yet again:—

> "Spoerer's Law of Spot Zones is only approximately true, and gives only a very general idea of sunspot circulation. Spoerer's curves are the integrated result of two, three, and sometimes four 'spot-activity track' curves, each of the latter falling nearly continuously in latitude." (*Ibid*, p. 152.)

Again, speaking at the Royal Astronomical Society, on 1903, May 8, Dr. Lockyer said:—

> "The general idea about the spot zones is that spots begin in a zone in high latitudes (about ± 30° to ± 35°), and this zone gradually approaches the equator until the spots vanish about latitude ± 5°, the new cycle commencing again in ± 35°. Now a glance at this diagram* shows that this is far from correct, because sometimes there are two, and occasionally three spot zones in existence in one hemisphere at one moment. Take the case of the year 1893, when you have three zones. The curves of Spoerer are, therefore, very misleading, for by taking the mean position of several spot zones you arrive at a latitude in which spots may not exist at all." (*Observatory*, 1903, June, p. 236.)

*The diagram of my paper communicated to the Society at this meeting, 1903, May 8

It was because these descriptions answered to nothing on the sun that I communicated a "Note on the Distribution of Sunspots in Heliographic Latitude" to the Royal Astronomical Society at its last meeting. I explained therein the nature of the mistake which Dr. Lockyer had made with regard to the maxima on which he based his paper, and that his method of joining them up so as to show apparent lines of drift was not only purely arbitrary, but was often against very distinct and positive evidence.

Is Dr. Lockyer's statement that his "*spot-activity* tracks" "are *not* tracks on the solar disc," and that his paper, read before the Royal Society in 1904, February 11, has been "misunderstood," intended as a withdrawal of these descriptions and definitions of "spot-activity tracks" which I have quoted—in fact, of all the main body of his paper? If so, I think it was a pity to publish in "Knowledge and Scientific News" a diagram to explain how he had been led to take up a position which he now finds to be untenable.

Dr. Lockyer objects to the note on p. 159 in this journal for July, and claims that Father Cortie rather corroborated than opposed his result. I do not so read Father Cortie's paper. His words are:—

> "These facts, however, as to the persistence of the disturbance in definite regions at some epochs, and dearth of spots at others, do not lend much countenance to the view of the variation in latitude being affected by a series of 'spot-activity tracks.'" (*Monthly Notices*, Vol. LXIV., p. 766.)

The last two sentences in Dr. Lockyer's letter form a claim which ought not to have been made. He says:

> "I pointed out, as one of the main results of my investigation, that outbursts of spots in high latitudes are not restricted simply to the epochs at or about a sunspot minimum, but occur even up to the time of sunspot maximum." ("Knowledge & Scientific News," 1904, August, p. 182).

Dr. Lockyer's "investigation," so far as it relates to the years 1874-1902, consisted solely in taking the results of my paper, prepared by the desire of the Astronomer Royal for the Royal Astronomical Society, 1903, May 8, and adding the figures there given, in sets of ten, of five, and of three. A computer of average skill would do this easily in a couple of hours. But the effect of this treatment would not be to bring out the fact to which he alludes, but rather to obscure it. He found the fact ready to his hand, explicitly set forth in three-fold fashion in this paper of mine upon which he was avowedly working. It was set forth in the diagrams, in the numerical tables, and in the brief preliminary text. The latter ran thus:—

> "Spots in a higher latitude than 33° were at all times rare, and when seen were never large or long-lived. Taking them as a class by themselves they were seen irregularly, appearing at times which did not seem to bear any fixed relation to any one of the four chief stages of the sunspot cycle—minimum, increase, maximum, and decline. Omitting these spots in very high latitudes—a term which would cover a zone 10° wide in each hemisphere, from 33° to 42°, for no spots were observed in a latitude greater than 42°—the years of maximum, 1883 and 1893, showed spots in practically every latitude between 30° north and 30° south, and they were numerous from about 8° to 24° in both hemispheres." (*Monthly Notices*, Vol. LXIII, p. 452.)

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A New Departure in Nature Printing.

By T. E. James.

The production of impressions of leaves, ferns, lace, feathers, or other natural and artificial objects by methods adapted to illustrate their outlines and surface features, has long engaged the attention of experimentalists. The records of old attempts in these directions are, indeed, of singular interest. They point to extraordinary industry on the part of workers in the art, though this frequently outstripped manipulative skill, a circumstance, perhaps, not to be wondered at, considering the means at hand, and the operative difficulties.

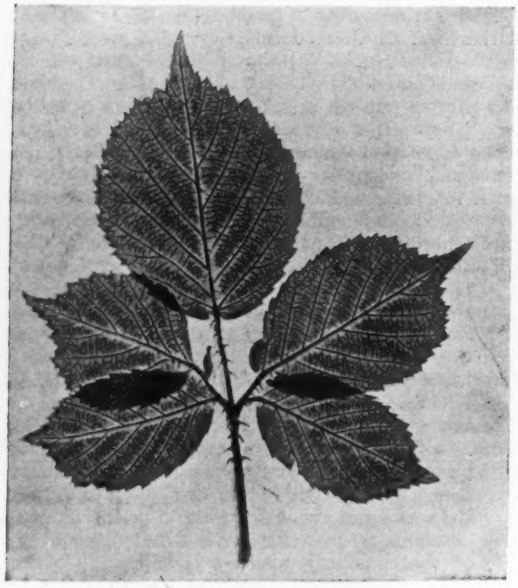
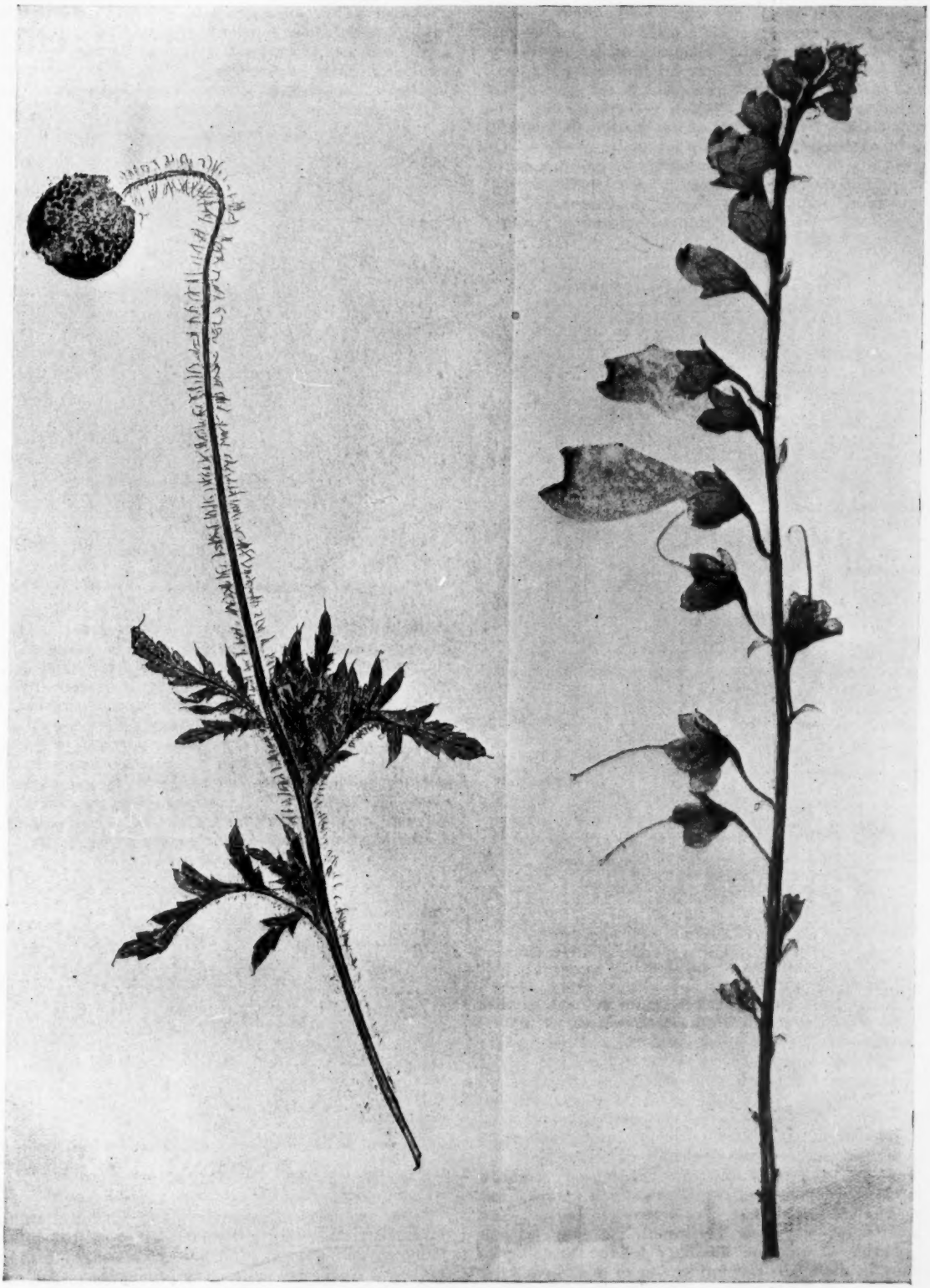


Fig. 1.—Blackberry Leaf.

We read of an observer who, in 1650, obtained nature-prints of the dried leaves of plants by the aid of sooty depositions. When the leaves were placed between paper and carefully rubbed over, the adherent smokiness was transferred, leaving a pictorial representation of the objects. Prof. Kniphof, of the University of Erfurt, published at Halle, 1757-61, his "Herbarium Vivum," a curious work in twelve folio volumes, which contained no fewer than twelve hundred printed plates of natural impressions. A single plant specimen is depicted on each plate, in many cases portraying its whole aspect, all the examples being hand-coloured. The title-pages carry a border of plants, introduced for ornamental purposes; and on some of these appear butterflies in brilliant natural hues. It seems that printer's ink was used to obtain the initial impression, combined with pressure on the object. Kyhl, of Copenhagen, was also engaged in 1833 in inventive methods. He describes his process thus:—"As a correct copy of the productions of Nature and Art must be of great importance, I submit a method I have discovered, whereby copies of most objects can be taken, *impressed into metal plates*, which enables the naturalist and botanist to get representations of leaves, scales, etc., in a quick and easy way; these copies will give all the natural lineaments with their most raised or sunken veins and fibres; and the artist can, by means of this invention, make use of Nature's real peculiarities; while the merchant can produce patterns of delicately-woven or figured stuffs, laces, ribbons, and so forth." Subsequently, in 1851, Dr. Branson communicated to the Society of Arts his views on the practicability of adopting the electrotype process for the accurate reproduction of original impressions, when the latter were taken in gutta percha. This marked a long stride in advance, and following it, came the adoption of lead as a mould, coupled still with the electrotype system of casting a durable copy. At this stage, Worring, of Vienna, made many notable improvements, which led to important practical results. In 1859, appeared the nature-printed "Ferns of Great Britain and Ireland" (Bradbury), and, in 1859-60, Johnstone and Croall's "Nature-Printed British Seaweeds." Mention should also be made of a paper in the Vienna *Denkschriften*, in 1894, which was illustrated by nature-printed plates of beech leaves, in sepia monochrome.

The ingenious "Physiotype" reproducing system, now being brought to notice, is due to the inventive skill of Mr. Francis Sheridan, who has patented the process. In this, inks or other fixing media are superseded, the novelty of the method consisting in the use of a fine powder, the chemical action of which is responsible for the fac-simile. The modus operandi, as carried out by Mr. Sheridan, is exceedingly simple. An object

Fig. 2.—Leaf of Woundwort.



Figs. 3-4.—"Physiotype" Impressions of the Poppy and Foxglove (natural size).

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for reproduction is placed upon white paper, and suitable pressure is applied by the hand or other means. The operation leaves no visible trace of an impression, nevertheless, when a small quantity of the powder is lightly passed over the paper, an impression appears on the surface, delineated as a print in the style of our illustrations. Each is absolutely permanent. The author claims a wide range of application for his process in nature-printing, and printing by contact. Its adaptability for the rapid production of impressions of the thumb and finger, of the palm of the hand, or sole of the foot, may be very readily demonstrated, and strictly "while you wait." Representations of flowers,

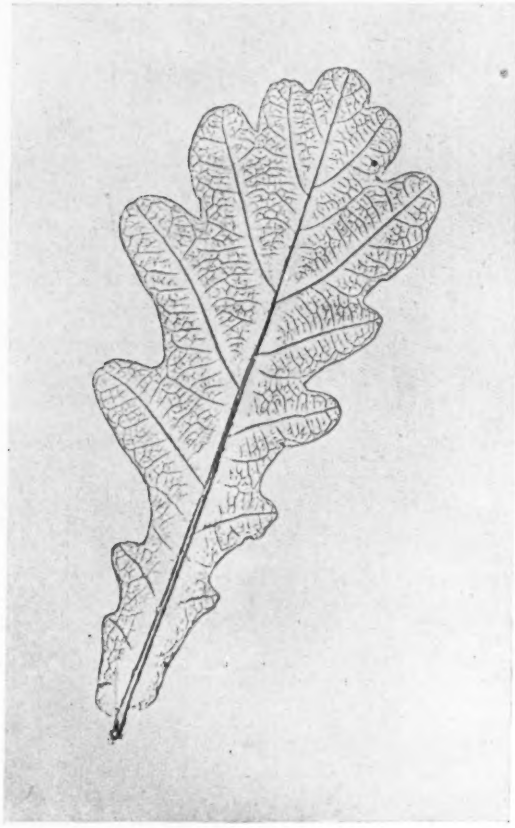


Fig. 5.—Oak Leaf.

leaves, grasses, ferns, wood sections, and similar natural objects are also within its province; as well as fac-similes of lace and other patterns, and the designs on coins and medals. One of the advantages of the "Physiotype" print is that it can be used as an artist's lithograph and transferred to stone, zinc, or aluminium. By this means it is possible to print off any number of impressions, and to produce them, if required, in one or several shades of colour.

The precise applicability of "Physiotype" records, and the development of the process as a nature-printing method need not be discussed here. But, if we may say so, it would certainly appear to provide a welcome auxiliary to the teaching of botany in the field. The production of a *self-picture* of the leaves, fruit, or other parts of a freshly-gathered plant is readily obtainable by its means, and the results are of a decidedly attractive and instructive character. As an adjunct to the pursuit of "Nature Study," it should prove of great value in stimulating the latent observational faculty of children. With the interesting prospect before them of producing a pictorial fac-simile of a living leaf, flower, or section, boys and girls might

Fig. 6.—Impression of a Section of Wood.

be the more easily persuaded to collect material from the countryside. For example, a series of leaves might be brought together illustrative of their composite qualities of structure, that is to say, of contour, venation, serration, difference between upper and lower side, and so forth. The teacher would apply the lesson. Our photographs from "Physiotype" impressions of leaves (figs. 1, 2 and 5) demonstrate the point. Again, entire specimens of plants are susceptible of teaching effort, where the mode of inflorescence is noted, form of bud and corolla, attachment of anthers, the presence of stipules, hairs, and other characters of growth.

Fig. 7.—Finger Prints showing Whorls (reduced).

Some examples of common plants in flower at the time of writing were gathered and submitted to the "Physiotype" process. Each was essentially a living specimen, and no more was done in preliminary manipulation than to use such slight pressure as would ensure the flatting down of the plant in a natural

position before laying it upon the white paper which was to receive the invisible impression. Our illustrations (figs. 3-4) are of the poppy and foxglove. With practice, no doubt, it would be possible to obtain even better results than are here given. Still they very fairly represent the outcome of a provisional trial to secure the reproduction of living plants.

Fig. 8.—Enlargement of a Rolled Finger-print.

Wood sections are well adapted for fac-simile. Fig. 6 is from a sample kindly lent by Dr. Russell, F.R.S.

The final illustrations (figs. 7-8) demonstrate finger printing.

On all grounds Mr. Sheridan deserves to be congratulated on what we must recognise to be an exceedingly interesting development in nature-printing.

Birkbeck College.

The new session of Birkbeck College, which begins on Monday, October 3rd, will be opened by an address delivered by Dr. Mackenzie on "The Influence of Pure Science on Progress." Among those who will deliver lectures or addresses on the Wednesday evenings during the coming session are the Dean of Ely, Colonel Sir Thomas Holdich, Sir Robert Ball, and the Rev. J. M. Bacon. From the calendar of the session 1904-1905, which comprises the usual day and night classes for the preparation of candidates who enter for the preliminary, intermediate and final examinations for the London University Degrees in Science and Arts, we learn that during the first term last year the class entries were, evening, 3166; day, 582. During the year sixty-four students passed examinations of the University of London (seven with honours), while other distinctions—scholarships, exhibitions, prizes, certificates, and medals—were gained at the examinations of various boards and societies; twelve students were successful in the examinations for Assistant Surveyor of Taxes, ten gained appointments as Assistant Examiners in the Patent Office, and others obtained good appointments in other branches of the Civil Service. Beyond this testimony to the practical service of the "Birkbeck" to the persevering student, other testimony must be borne to the excellent work it is doing in spreading the systematic practical knowledge of science among its widely distributed constituency.

NOTES.

ASTRONOMICAL.

Annals of the Harvard College Observatory.

Two contributions have recently been issued under the auspices of Harvard College. The first of these is the volume for 1901 and 1902 of the Blue Hill Meteorological Observatory, and the expense of its publication only is borne by Harvard College, all the expenses of the observing stations, instruments, and investigations being borne by the Director, Mr. A. Lawrence Rotch. In addition to maintaining the routine observations and automatic records at three stations—one at the Blue Hill Observatory itself, a second at the base of the Great Blue Hill, and a third at the Neponset Valley—several investigations were undertaken, chief amongst which was the exploration of the air with kites. Mr. Rotch is the American member of the International Committee for Scientific Aëronautics, and as far as possible flew his kites on the specified international days, and when flights were not made on these days, it was due to lack of wind at the ground, as a velocity of at least six metres per second is required. If it is desired to certainly fly a kite on any particular day, Mr. Rotch advises the instalment of the apparatus on a steamer, which by creating a wind through its motion will enable a sufficient current of air to raise the kite. He advises by this means an investigation of the meteorological conditions above the trade-wind and doldrums. Other investigations have also been conducted on the audibility under various weather conditions, at Blue Hill; of the effect of weather conditions on the optical refraction of the lower atmospheric strata; and of the electrification of the air and the quantity of carbon dioxide contained in it. These last measurements seem to indicate that there are two maxima of potential during the day, which are not always well defined, and sometimes merge into one, occurring about noon or a little before, and in the majority of cases there is a steady fall of potential from about 2 p.m. until late in the evening, when the electrification seems to reach a constant and low value.

The second contribution from Harvard College is the determination by Mr. Winslow Upton, during the year 1896-97, of the position of the Arequipa station in Peru. Briefly it results:—

Latitude, − 16° 22′ 28·0″.
Longitude, 4h. 46m. 11·73s. west of Greenwich.
Height above sea-level, 2451·4 metres = 8043 feet.

Harvard College itself issues its circular (No. 74) on variable stars of long period, and urges that in such cases it is useless for observers to employ Argelander's exact method of sequences. As it is, when the measures made at different observatories on the same night are compared, they often differ by half a magnitude or more, owing chiefly to the red colour of most of the long-period stars. The resulting magnitudes would be nearly as good if the observer would merely state that the variable was surely brighter than one star and fainter than that next it in the sequence, without attempting to estimate grades. Considering the large number of variables of which we have no current observations, our knowledge of their variations could thus be greatly and easily increased.

* * *

Bulletins of the Lowell Observatory.

A number of interesting bulletins (Nos. 9-13) have arrived from the Lowell Observatory, and indicate the varied and valuable researches that are carried on there. In No. 9 Mr. Lowell gives a new determination of the position of the axis of rotation of Mars, championing the direct and observational

method as used by Schiaparelli, rather than the direct method used by Struve, of the calculation from the nodal or absidal precession of its satellites' planes. Incidentally Mr. Lowell points out that there is a strong discordance between the results of Schiaparelli and Struve. Mr. Lowell's own results are as follows:—

Position upon the Earth's Equator	315° 32′. R.A.,	54° 51′ Dec.
Intersection of Martian Equator and Martian Ecliptic	85° 56′.	24° 32′.
Inclination of Martian Equator to Ecliptic . .		22° 55′.

In No. 11 Mr. V. M. Slipher gives a list of five stars which he suspects to be spectroscopic binaries. These are Alpha Andromedæ, Alpha Libræ, Sigma Scorpii, X Sagittarii, and Epsilon Capricorni.

In No. 12, on "The Cartouches of the Canals of Mars," Mr. Lowell restates his conclusions: (1) The canals develop down the latitudes after the melting of the polar cap, the development proceeding across the equator into the planet's other hemisphere; and they do this alternately from either pole. (2) The canals are from their behaviour inferably vegetal. (3) They are of artificial construction.

In No. 13 Mr. Slipher gives plates and details of the spectra of Neptune and Uranus. He notes that he finds indications that free hydrogen is very plentiful in the atmosphere of Neptune, and is abundant on Uranus, but not so much so as on Neptune. He also considers that some unknown light gases related to hydrogen and helium might also be present and account for certain unknown bands. Helium he could not observe with certainty owing to the insensitiveness of his isochromatic plates in the D region of the spectrum.

In one matter astronomers certainly owe a debt to Mr. Lowell—namely, for his introduction of new words—words that are at least new to the very limited astronomical vocabulary. The expression "cartouches" is a case in point; and another is offered by bulletin No. 9, where he says that "for direct handling of the subject the planet's polar caps offer the most trustworthy 'helves.'" We scarcely think the use of the terms "expurgated" and "unexpurgated" in the same bulletin so happy. They suggest Mr. Bowdler, and that Mr. Lowell's bulletins are unsuitable reading for the young person.

* * *

The Royal Astronomical Society of Canada.

The Astronomical and Physical Society of Toronto has been accorded the above new title, and has just issued its selected papers and proceedings for 1902 and 1903, which prove very interesting reading. The President's address for 1903 reviewed the recent researches in cosmical physics. Mr. W. H. S. Monck gives a valuable catalogue of aërolites, and Mr. Arthur Harvey follows it by a paper on "Shooting Stars and Uranoliths," with special reference to the Mazapil (Mexico) meteorite. He supplements Mr. Monck's catalogue, and concludes that "aërolites are evenly distributed throughout space and move at various angles with the plane of the ecliptic," so that there is no evidence to show that there are drifting clouds of matter in space which might be the exciting cause of solar and our own magnetic disturbances. A second paper by Mr. Harvey is practically a continuation of the same subjects, and is called the "Vagaries of the Mariner's Compass." In this is passed in review the researches which have been variously carried on both in terrestrial magnetism, on auroral displays, and on the solar work at the Greenwich and Yerkes observatories. The final paper is on "Women's Work in Astronomy," by Miss Elsie Dent. This is a most disappointing one; it is undiscriminating and full of errors. What is most striking is the number of omissions of the names of American women astronomers. The writer places both Mademoiselle Klumpke and Madame Flammarion at the Paris Observatory, and she places Lady Huggins in the same rank as the last named, both as deriving their astronomical rank solely from their husbands' position—a gross injustice to Lady Huggins. Miss Dent is unaware that Miss Klumpke left the Paris Observatory some three years ago to marry Dr. Isaac Roberts. She describes Miss Elizabeth Brown as having been sent to Russia in 1887 to observe the Total Solar Eclipse of that year by the British Astronomical Association, which was not in existence until three years later.

Meteoric Observation.

Mr. W. F. Denning writes from Bristol:—

"Perhaps more mistakes have been made in this department than in any other field of astronomy. Certainly some of the observations have been very wild, and more obviously calculated to excite ridicule than to win confidence. In this, as in other branches of observation, it would have been better had certain observers never essayed to do anything, since their results are affected by personal equation or individual idiosyncrasies of such marked character that their work rather damages than benefits the cause. There is no doubt that the majority of the radiants hitherto determined are useless, being either pseudo positions or so inaccurate that their elimination is desirable. Their retention and combination with correct radiants have the effect of detracting from the value of the latter.

"To attempt to detail the errors made in this branch would serve no useful purpose, and it would occupy a large amount of space. One observer, a few years ago, watched the Perseids, and saw the meteors shooting not from the radiant, but towards it. Numbers of meteors were recorded in Camelopardus and surrounding constellations, but all of them were dashing towards the radiant!

"Another observer noted that many Perseids, after traversing their paths, made return journeys along the same paths. He also saw many large cloud-like meteors, and the sky produced flashings, coruscations, &c., which he attributed to meteoric action.

"Other observers frequently record meteors whose paths are suddenly bent or crooked. Others, again, frequently note curved paths, and some observers see meteors which suddenly stop and shoot back nearly in an opposite direction.

"Practice, experience, and care will not always form a good observer. The most essential quality is self-aptitude or natural capacity which varies greatly in different individuals. Meteoric observers, like poets, are born, not made. Education can never ensure very high proficiency unless the learner possesses inherent qualities which materially help him to acquire it.

"As far as my experience goes, there have been observers whose radiants cannot be relied on to within 10°; there have been others whose positions can be depended upon to within 2° or 3°. Unfortunately it is often impossible to certainly single out the good from the indifferent positions, and so our accumulated results form a curious medley of precise and pseudo results. Though this is undoubtedly the case, however, we know the correct radiants of a considerable number of showers.

"Fortunately we have many reliable observers working to-day at this department, and I need only mention the names of Astbury, Backhouse, Besley, Bridger, Brook, Alex. Herschel, and King.

"Other good men, such as Blakeley, Booth, Clark, Corder, R. P. Greg, Wood, and a few more, have relinquished labours in this field.

"Prof. Alexander S. Herschel has accomplished a vast amount of valuable meteoric work during the last 45 years, and this department of astronomy will ever stand indebted to him as one of its most able and tireless pioneers."

* * *

A New Chart of Mars.

Herr Leo Brenner has recently issued a new chart of Mars from observations made in Lussinpiccolo from 1894-1903. The chief feature of the chart is the indication of the minor markings, "canals" and "lakes," in different colours according as they have been discovered by Schiaparelli, Lowell, or by Brenner himself. The result is a network of lines so close and intricate as to prove to demonstration that it cannot possibly represent any real and permanent features of the surface of the planet. The majority of these markings, exceeding three hundred in number, if actually observed must belong to one of two classes; they must either be pure illusions on the part of the observer or must be perfectly ephemeral markings on the planet, possibly of the nature of meteorological change. The leading markings, the great "lands" and "seas," are shown under forms so stiff and rectangular, and with so little of detail, as to indicate that Herr Brenner enjoyed very few advantages as to atmosphere or telescopic definition, or else that he was singularly unfortunate in profiting by them.

XUM

A Scheme for the Comparison of Climates.

Is it possible to express the pleasantness or unpleasantness of a climate on a scientific scale? Captain W. F. Tyler, F.R.Met.Soc., has attempted to form such a scale. Concluding that the two dominant factors influencing our sensation of comfort are temperature and humidity, he has coined the word "hyther"—apparently from the first syllables of "hygrometer" and "thermometer"—to indicate this joint effect. A perfectly pleasant day is registered 0 on this hyther scale, and an intolerably oppressive one as 10. Captain Tyler's own observations of "hyther" extend over several years, but in the end of the summer of 1902, he was able to get the co-operation of eleven other observers for the systematic observation of "hyther" throughout the month of August. The results of the comparison showed that most persons would require a considerable amount of practice before their observations could be considered trustworthy, but some approach was made towards the establishment of a definite law connecting the temperature and humidity with the hyther sensation. At the same time there were indications that some other factors, possibly barometric pressure or electric conditions, had an appreciable influence upon the sensation. The subject seems well worth working out on a more extended scale.

* * *

The Paris Observatory.

The annual report of the Paris Observatory for 1903, presented to the Council on March 22 of the present year, deals with a number of researches of special interest. The seventh section of the Atlas of the Moon has appeared, containing seven plates which seem the most successful yet issued, and in some respects to show a considerable advance over the best views of the moon obtained by the eye at the telescope. With respect to the Astrographic Chart, eleven plates have been passed as satisfactory, and thirty-five charts containing the triple images of 47,300 stars have been distributed. It is hoped that the second volume of the Photographic Catalogue will appear by the end of the current year. The determination of the solar parallax from the photographic observations of Eros is advancing towards completion. Of standard stars 1661 meridian observations have been made, and 10,858 photographic observations of comparison stars, of standard stars, and of stars near the path of Eros. Three important researches based upon new methods are included in the programme for the future work of the observatory: the first relates to the determination of latitude and of its variations; the second is for the precise determination of the constant of aberration, two portions of the sky, distant 90°, being presented in the field of the instrument at the same moment by means of a double mirror; and the third relates to the employment of M. Lippmann's photographic object-glass in meridian observations.

* * *

Re-discovery of Encke's Comet.

Encke's comet was re-discovered at the Königstuhl Observatory on September 11 at 13h. 16·9m. local mean time. Its right ascension at discovery was 1° 46′ 16″, and its declination N. 25° 24′. This is the thirty-sixth return of the comet since its discovery in 1786; the twenty-ninth during which it has been observed.

BOTANICAL.

By S. A. Skan.

The *Comptes Rendus*, vol. cxxxvii., contains some valuable observations on the germination of seeds of orchids by Mons. N. Bernard, whose experiences warrant his making the interesting and rather remarkable statement that germination, at least in the case of some seeds of *Cattleya* and *Laelia* with which he experimented, is wholly dependent on the presence in the embryo of a filamentous endophytic fungus. In a fortnight after sowing the seeds some minute spherules, rendered evident by their green colour, were produced. Some of the epidermal cells of these bodies elongated into short papillæ, but did not form any true hairs. It was observed that in aseptic sowings, even after the lapse of five months from the time when the green spherules made their appearance, no further development of the seeds had taken place. Many were destroyed by mould, sooner or later. If, however, the seeds in the state indicated were transferred to a tube in which was a culture of a certain hyphomycetous fungus, further growth almost immediately resulted, and it was found that the hyphæ of the fungus had penetrated the median part of the suspensor and the adjacent cells of the embryo. In fifteen days the seedlings had assumed their characteristic top-shaped appearance, developing a terminal bud and long absorbing hairs. In the cultures, besides the fungus which Mons. Bernard regards as necessary to germination, a coccobacillus was present, but it did not appear to have any effect, either in hindering or promoting germination; if, however, other fungi or bacteria were substituted for the particular kind of fungus found to be essential, the seeds, instead of germinating, were destroyed.

A rose which has created a great deal of interest in horticultural circles is the subject of one of the plates in the September number of the *Botanical Magazine*. The late Sir Henry Collett met with this rose, to which he gave the name of *Rosa gigantea*, as a very striking object in the forests of the Shan Hills in Northern Burma, and it was through him that seeds were received at the Royal Botanic Gardens, Kew, in 1888. No difficulty was experienced in getting the seeds to germinate, and the seedlings soon developed into plants remarkable for the enormous length of their shoots, one of these in the Temperate House reaching a length of fifty feet. Visitors to the Succulent House may have observed the robust specimen planted in the central bed there, which had grown along the roof, and then out through a ventilator into the open air. But though growths were produced in almost embarrassing freedom, no flowers have ever been borne by the Kew plants. Indeed, it is believed that only in two gardens in this country has the plant flowered at all. From one of these—Albury Park, Guildford—the material was obtained from which the *Botanical Magazine* drawing was prepared. The flowers are white, or white tinged with yellow, and are from four to six inches in diameter. The same rose was found first in Manipur, and it is now known to occur in Western China.

ORNITHOLOGICAL.

By W. P. Pycraft.

Brush Turkeys breeding in Confinement.

Mr. Bertling, in the August number of the *Avicultural Magazine*, concludes his notes on the breeding of the Brush Turkeys (*Talegalla lathami*) in the Gardens of the Zoological Society.

His account, though short, is extremely interesting and of considerable scientific value.

Some time since, these birds constructed a mound of the usual type, and deposited therein a number of eggs. The nestlings being overdue, it was at last decided to at least partially explore the mound, and this resulted in exposing three eggs. These lay about one foot apart from each other, and some 18 inches from the surface. They were placed with the large end upwards, and had certainly not been turned, as a deep hole, of the shape of the egg, was left on its removal. Moreover, the egg did not touch the bottom of the hole, inasmuch as the small end was quite white, whilst the rest of the shell was stained by contact with the mould.

A further search revealed a chick, evidently dazzled by the sudden glare of the light. The "quills" of this bird were nearly 3 in. long, and as it could fly fairly well, he says, "I have come to the conclusion that the young remain at least 36 hours, or longer, in the mound before making their appearance, as three others, hatched in an incubator, were not nearly so advanced when hatched."

The shell is very thin, so that the young do not chip round the upper part of the egg in order to make their escape, but

appear to shatter the walls of their prison by giving a violent wriggle. They do not immediately obtain freedom, however, but still remain encased in the inner membrane of the shell, which is ruptured some hours afterwards.

When first hatched the primaries and secondaries are ensheathed in a "thin filmy covering" which gives the wings the appearance of being still undeveloped, but directly the chick dries this membrane peels off, leaving the bird ready for flight.

At three weeks the black feathers of the adult plumage are distinctly visible through the "down," and at six weeks the birds are almost indistinguishable from the parents.

* * *

Breeding of the Tataupa Tinamou.

(*Crypturus tataupa.*)

Mr. Seth-Smith is the first to have succeeded in breeding this rare bird in confinement, and as nothing was hitherto known of its habits at this time his short description thereof in the *Avicultural Magazine* for August is of considerable interest.

The eggs are incubated by the male only. From the moment he began to sit the female resigned all interest in the matter; indeed, if she approached, her mate rushed at her open mouthed so that she fled in terror! Before leaving them the eggs were most carefully covered up. After the escape of the young from the egg shell the male broods them for some hours before bringing them out into the open.

The female does the courting, calling to her mate and then running to him, and displaying in the most curious attitudes.

When alarmed these birds adopt the peculiar device of throwing themselves forward on the breast and throwing the tail in the air so that the under-tail-coverts form a screen to hide the body; which in consequence becomes hard to distinguish from the surrounding herbage and undergrowth. Even very young chicks, when they suspect danger, squat and turn up their sprouting tails, but whether instinctively or in imitation of the parents the author does not say.

* * *

The Weight of Eggs.

In our last issue, it will be remembered, we referred to a paper on the loss of weight of eggs during incubation. The *Zoologist* for August contains some extremely interesting notes on the range of variability in the weight of eggs of wild birds, which is much greater than one would have imagined. The eggs of the Charadriidæ were used to furnish the material for this investigation, and the strictest care was used to select only unincubated eggs, thus eliminating the error due to loss from this cause. The weight of the whole clutch, and not of single eggs, is given. Altogether, about a dozen species have been studied in this connection, and four or five clutches of each species have been weighed. In *Ægialits hiaticula*, the lightest clutch weighed 45·148 grammes, the heaviest 50·450 grammes; in *Charadrius pluvialis* the differences were 130·167 grammes and 151·299 grammes; in *Vanellus vulgaris*, 106·621 and 117·434 grammes; in *Numenius arquatus*, 320·114 and 348·116 grammes; in *Totanus calidris*, 82·164 and 92·687 grammes. It would be interesting to compare the relative differences in weight between the birds of the species enumerated and their egg clutches, and to note the difference between the activity of their young on hatching. So far, no one seems to have noticed whether this differs to any appreciable extent among the different species of Charadriidæ.

* * *

The Systematic Study of Bird Life.

The foundation of an Ornithological Observatory is an event which may be said to mark an epoch in the study of ornithology. Such an establishment has just been started in the United States. It is to be known as the "Worthington Society for the Investigation of Bird Life," and has been erected and endowed by its founder, Mr. C. C. Worthington, on his estate at Shanee, Monroe County, Pennsylvania.

The programme laid down is exhaustive in its comprehensiveness, but we may draw special attention to one or two of its particularly interesting items. In the first place particular attention is to be paid to life histories. Observations on an elaborate scale are to be made so as to embody as many details as possible concerning the growth, food, and habits of individuals in a wild state. The study of the vexed question of variations, their nature, and cause; and colour changes with respect to age, sex, moult, season, and climate should yield much. The problems of heredity, experiments in hybridising, and psychological observations are to be carried on in specially constructed aviaries. Another important feature is the proposal to test the possibility of breeding insectivorous and other useful birds with a view to re-stocking depleted areas, as has been done in the case of fish by the Fish Commission.

The carrying out of this great enterprise has been entrusted to Mr. W. E. D. Scott, the Curator of the Ornithological Department of the Princeton University. This augurs well for its success; indeed we know of no other man who is so peculiarly fitted for such a task. He will be aided by a staff of assistants.

We cannot refrain from expressing a desire to see a similar institution at work in this country. Perhaps the Board of Agriculture may be induced to consider the matter.

* * *

Snap-shots from Bird Life.

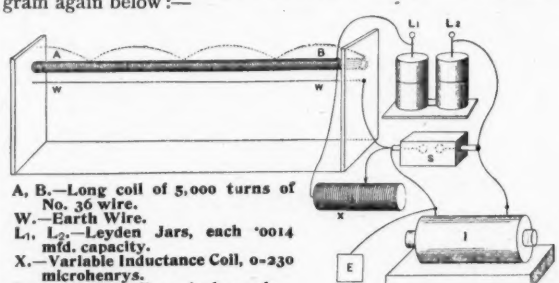
We have peculiar pleasure in bringing to the notice of our readers a very wonderful collection of stereoscopic pictures which have just been issued under the above title. Every picture has been taken from life—and about their genuineness there can be no question—by M. P. L. Steenhuizen, of Amsterdam. Though these photographs were taken in Holland, all the birds in the series occur in Great Britain. A more marvellous and a more beautiful collection it would be impossible to imagine, and at the present time they are probably unique. Since there are no less than 48 slides in all, we cannot give a list of the subjects, and we find it peculiarly difficult to select any for special mention, for all are alike exquisite. But to give an idea of the variety of the selection, we may mention as especially striking the nest and eggs of the pheasant, the nest and young of the marsh harrier, the nest and young of the spoonbill, the nightjar and its eggs, and the nest and eggs of the great reed warbler.

I shall be glad to give particulars to those who may desire to procure copies of this really wonderful series.

PHYSICAL.

Electrical Wave Measurement.

In the June number of "Knowledge," a description was given of the means which Professor J. A. Fleming, F.R.S., employs to investigate the propagation of electric waves along spiral wires; and a diagram was appended to show the way in which the apparatus can be employed for measuring the length of waves used in wireless telegraphy. We reproduce the diagram again below:—



A, B.—Long coil of 5,000 turns of No. 36 wire.
W.—Earth Wire.
L_1, L_2.—Leyden Jars, each ·0014 mfd. capacity.
X.—Variable Inductance Coil, 0-230 microhenrys.
I.—Induction Coil—10 inch spark.
S.—Spark balls.

In practice the method consists of establishing stationary electric waves on the spiral wire, and of deducing, by mathematical reasoning, the wave length of the induced wave. The experiments described previously in "Knowledge" were made with a long helix of insulated copper wire, wound in one layer on a wooden rod. Wood, however, has since been found to be unsuitable for obvious causes; and an ebonite rod

has been substituted. The helix of wire consisted of 5000 turns, the length being 200 centimetres. If such a helix is placed in connection with an oscillating circuit consisting of a condenser or Leyden jar, a spark gap, and a variable inductance, stationary waves can be set up on the helix by adjusting the inductance in the oscillating circuit. In order to detect the nodes and antinodes of these stationary oscillations, Professor Fleming makes use of a vacuum tube, similar to that used in spectrum analysis, and preferably one filled with the rare gas, Neon. Rarefied Neon seems to be extremely sensitive to the presence of variable electric force through it; hence, if such a tube is held perpendicular to the helix, and moved parallel to itself along it, it glows brightly at the antinodes, but not at the nodes. In this manner the internodal distances can be measured with considerable accuracy, and the wave-length of the stationary oscillation measured.

Now the velocity with which the wave is propagated along the spiral can be shown to be inversely proportional to the square root of the product of the capacity and inductance of the helix per unit of length. Professor Fleming has perfected of late years methods for measuring very small capacities and inductances, and in the case of the above-named helix the inductance is equal to 100,000 centimetres per centimetre, whilst a capacity of the helix is $\frac{7}{10}$ of a micro-microfarad. (1 micro-microfarad = 10^{-6} microfarad.)

From these data the velocity of propagation of electric waves along the helix can be shown to be 235,000,000 centimetres per second. This figure is confirmed in the following manner: The capacity and the inductance in the oscillating circuit are both measured when the first harmonic oscillation is formed on the helix, and under those conditions the half wave-length was found to be 140 centimetres, whilst the frequency in the oscillating circuit, as calculated from the capacity and inductance, was found to be $0{\cdot}847 \times 10^6$.

Having, therefore, the wave-length and frequency, we find their product gives a velocity of 235,000,000 centimetres per second, which agrees with the figure determined from the constants of the helix.

The best form of inductance to be employed in connection with the oscillating circuit is a square of one turn of wire; the employment of spiral coils leads to errors due to passage of a dielectric current from coil to coil. The improved instrument which Professor Fleming has now constructed, and which is based on the foregoing considerations, he calls a "Kummeter." It is constructed as follows: A long ebonite rod is wound over closely with silk-covered wire in one layer, and this is supported on insulating stands. On this long helix slides a metal saddle having some layers of tinfoil interposed to make good contact between the saddle and the helix. This saddle is connected by a flexible wire with the earth. One end of the helix is furnished with an insulated metal plate, which is placed in apposition to another metal plate connected to the oscillating circuit of the transmitter. The process of measuring the wave consists in sliding the saddle along until a Neon vacuum tube indicates the presence of one node half-way between the saddle and the plate. When this is the case the distance from saddle to plate is one wave-length of the stationary wave on the helix.

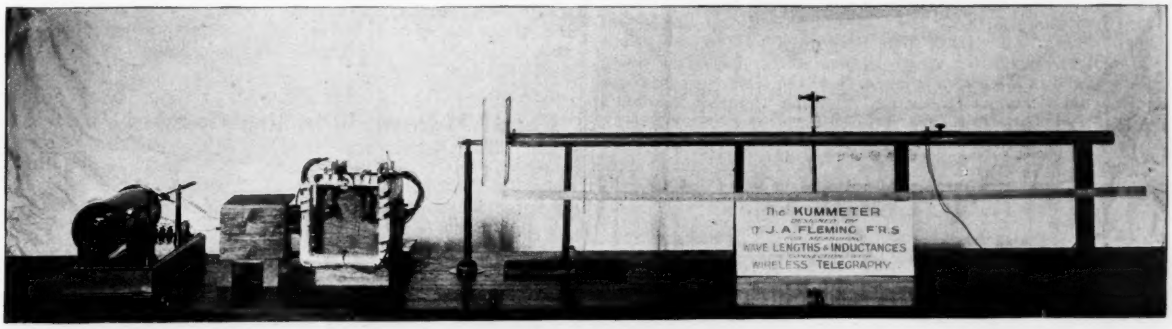
From the constants of the helix the velocity of the wave along it can be calculated as above shown, and hence the frequency of the oscillating circuit becomes known. If this frequency is divided into the velocity of light, reckoned in feet, it gives the wave-length in feet of the wave radiated from the associated aërial, provided that the aërial radiating wire has been tuned to be in resonance with this oscillating circuit.

This instrument also provides the means of measuring small inductances, and also the frequencies in oscillating circuits, which are much higher than those which can be determined by photographing the spark.

* * *

Thought Rays.

M. di Brazzà, a student at Liège, who sent an account of Becquerel's work on radio-activity to the *Secolo XX.* for January, 1903, now describes the I-rays as discovered by himself when repeating the N-ray experiments of M. Blondlot and of Professor Charpentier. Charpentier succeeded in demonstrating that the human body emits N-rays. He found that the phosphorescence of certain substances is increased when they are brought close to a nerve or contracting muscle, *i.e.* muscular work is accompanied by a marked emission of N-rays. By means of a simple apparatus, a lead tube 7 cm. long (lead was chosen because it was opaque to the human rays, and accordingly lessens diffusion), closed at the end by a sheet of paper, or bit of silk covered with phosphorescent calcium sulphate, it is possible to observe the different nervous centres of the cerebral cortex. Thus by placing it in apposition with Broca's centre (the centre of articulate speech) while the patient is talking, variations are produced in the luminosity of the phosphorescent calcium sulphate. In another experiment, Charpentier saw the phosphorescent substance shine all down the line of its application to the spinal cord. Charpentier concluded that the emission of rays goes *pari passu* with activity of function, whence we should be in possession of a new method of studying nervous and muscular activity. Di Brazzà claims to have demonstrated what Charpentier only surmised, *i.e.* that "the brain is the seat of active radiation." The I (Italy) rays differ from the N in that they can pass through moist substances, and are not bent nor refracted. Di Brazzà observes them directly and indirectly. In direct observation he applies a phosphorescing screen treated with platinocyanide of Ba., or other phosphorescent substances, to the patient's head. The screen is faintly illuminated by a radiographic tube (tubo-focus) enclosed in a wooden box. When the subject concentrates his will, curious oscillations appear in the luminosity of the screen in relation with the patient's psychical activity. When his attention is not concentrated, the light does not flicker. The rays are not emitted equally from all parts of the head. They are *nil* at the forehead and upper part of Broca's centre, increase at the temples and eyes, and reach their maximum behind the ears. In photography, precautions must be taken to secure uniform length of exposure (di Brazzà introduces an automatic interrupter), sensitivity of plate, conditions of development, &c. Di Brazzà always uses ortho-chromatic plates.



Professor Fleming's Kummeter.

Wireless Telephony.

In order more closely to investigate the phenomena attending the disruptive discharge of a Ruhmkorff coil, Mr. F. Lifchitz, as recorded in a paper recently presented to the Russian Physico-Chemical Society, places a concave mirror on the axis of the Ducretet commutator working the coil. On account of the synchronism, a fixed image of the spark is obtained on the screen instead of a Federsen band, as obtained in the case of the rotation of the mirror being much more rapid. The image observed is a single one in the case of the spark length being maximum, 2, 3, etc. images—up to some dozens—being realised as the distance of the electrodes from the spark becomes less. In order to be able to record these observations, the author fitted a photographic plate instead of the mirror vertically to the axle of the commutator, when the images of the sparks followed up each other at increasing intervals, beginning with $\frac{1}{18000}$ second. This goes to confirm Hertz's opinion, according to which the discharge of the coil would carry an amount of electricity much greater than that of an electrostatic machine in virtue of the more rapid increase in potential. The number of impulses obtained for the same length of spark varies directly as the intensity of the current traversing the primary circuit. Now let the commutator of the coil be replaced by a microphone acted upon by the voice of the experimenter. Each letter pronounced will result in a series of disruptive discharges, the series of impulses being the longer as the pulsations are stronger. The vibration thus set up may be received by the aid of a decoherer. A whole series of vibrations following up each other at intervals of some 10,000th of a second will result in a single variation in the resistance of the decoherer, being the greater as the series is longer, and the time necessary for producing decoherence being of some thousandths of a second.

ZOOLOGICAL.

By R. Lydekker.

The Blood of Men and Apes.

At the Anthropological Congress recently held at Greifswald, Professor Uhlenhuth described at considerable length the results of experiments he had undertaken with the view of ascertaining whether any closer affinity exists between the blood of the man-like apes and that of man than between the latter and the blood of the lower monkeys and mammals in general. The result is to show that, although it is perfectly easy to distinguish between human blood and that of the lower mammals, it is much more difficult to demonstrate under the microscope a satisfactory distinction between the former and that of apes and monkeys. But this is by no means all; for, whereas the resemblance is greatest between the blood of man and that of man-like apes, it becomes less strongly marked when that of the lower Old World monkeys is compared, still less so in the case of the American monkeys, and least of all when the blood of the lemurs is under comparison. This is exactly what might have been expected to occur, seeing that the lemurs depart most widely of all the Primates from the human type.

* * *

The Gorillas at the "Zoo."

The recent arrival at the Zoological Society's menagerie of two apparently healthy young gorillas was an event of great importance and interest. Unfortunately, the elder of the two (*ætat* 5) did not long survive, succumbing to a disease which was apparently already in its system at the time of its purchase. The other and younger animal, which was supposed to be three years old, has also died. Only two gorillas have previously been exhibited in the Regent's Park. The first of these was a young male, purchased in October, 1887, from Mr. Cross, the well-known Liverpool dealer in animals. At the time of arrival it was supposed to be about three years old, and stood 2½ feet in height. The second, which was a male, and supposed to be rather older, was acquired in March, 1896, having been brought to Liverpool from French Congoland by one of the African Steamship Company's vessels. It is described as having been thoroughly healthy at the date of its arrival, and of an amiable and tractable disposition. Neither of these animals survived long.

So long ago as the year 1855, when the species was known to zoologists only by its skeleton, a living gorilla actually existed in this country. This animal, a young female, came from French Congoland, and was kept for some months in Wombwell's travelling menagerie, where it was treated as a pet. On its death, the body was sent to the late Mr. Charles Waterton, of Walton Hall, by whom the skin was mounted in a grotesque manner, and the skeleton given to the Leeds Museum. Apparently, however, it was not till several years later that the skin was recognised by the late Mr. A. D. Bartlett as that of a gorilla; the animal having probably been regarded by its owner as a chimpanzee.

Of the two recent arrivals at the "Zoo.," one appears to belong to the true gorilla (*Anthropopithecus gorilla*), while the other represents the red-headed gorilla, which has been described as *Gorilla castaneiceps*. It is now definitely known that there are several local forms of gorilla, of which one inhabits East Central Africa; but naturalists are by no means in accord as to whether they should be regarded as species or sub-species. If the latter view be adopted, the gorilla should be included in the same genus as the chimpanzee (*Anthropopithecus*), but, if the former course be followed, it would probably be better to regard the various species as representing a genus (*Gorilla*) by themselves.

Whether it will ever be possible to keep a specimen in captivity in this country till full-grown remains to be seen. Since the above-mentioned 3-year old example was only 2½ ft. in stature, gorillas must probably take something like 15 or 16 years to reach maturity.

* * *

Fossil Mammals in the Ganges Valley.

An extremely interesting discovery of the remains of extinct mammals has recently been made during excavations undertaken for the foundations of the Ganges bridge at Allahabad, India. The remains include those of one or two species of hippopotamus, of a wild ox, and of an elephant, all belonging to extinct species. Apparently all these species are identical with those long known from the valley of the Narbada, considerably further south in India; but it is possible that the Ganges bones, like others discovered in the early part of last century in the valley of the Jumna, may belong to a somewhat later portion of the Pleistocene epoch. In all probability the creatures they represent were cotemporaries of the early human inhabitants of India; and the special interest of the discovery lies in the possibility that it may give rise to investigations for the purpose of ascertaining whether human remains may not occur in the same deposit. In connection with the former existence of hippopotamuses in India, it may be remarked that we have yet to learn why these animals died out while elephants survived.

* * *

Mammoth Skull in Kent.

We have also to record a very interesting palæontological discovery at Erith, in Kent. A short time ago it appears that while some labourers were working in a sand pit at that place, they came suddenly upon an entire skull of a mammoth, at a depth of about 23 feet from the surface, with tusks close on six feet in length. Unfortunately they forthwith proceeded to exhume the prize, which of course at once fell to pieces. Had it been properly treated with size and plaster, it might have been extricated whole, when it would have formed a most valuable specimen, as only one entire British mammoth skull is known.

* * *

The Later History of the Horse.

This subject was discussed at the late meeting of the British Association by Professor Ridgeway, who urged that while the ordinary "cold-blooded" horses of Europe and Western Asia trace their descent to a dun-coloured stock more or less nearly resembling the Mongolian wild ponies, Arabs and thoroughbreds are descended from a breed whose colour was bay, frequently with a white star on the forehead and a white ring on the fetlock. This ancestral bay stock, it is urged, originally came from North Africa, whence it migrated into Western

Asia. There is much in this theory to attract the best attention of the zoologist, although the absence of any evidence that wild horses ever existed in North Africa militates against an African origin for the bay stock. Moreover, when the author suggests that the white "stocking" on the fetlock of the Arab recalls the white rings on the foot of the zebras he is treading on dangerous ground, although he appears to have abandoned his wild theory that the Arab and the thoroughbred are descended from Grévy's zebra.

CORRESPONDENCE.

The Later History of the Horse.

To the Editors of "Knowledge."

Sirs,—Mr. Lydekker, in his interesting paper ("Knowledge," August, 1904, p. 171), makes a very usual error in dealing with the relative degrees of finish exhibited in Palæolithic and Neolithic implements. Without previous knowledge of the subject of prehistoric implements, a reader would gather that all Palæolithic implements are rude, and that all Neoliths are ground or polished. This impression would to a certain degree receive confirmation by a visit to Bloomsbury. Nothing in truth could be more misleading. If Palæolithic implements are regarded as a class, they show, especially with regard to later types, a remarkable proficiency in the working of flint. The only type which as a class can be termed rude are the oft-abused Eoliths; the Palæoliths certainly do not merit such a term. Again, it was the exception during Neolithic times to grind or polish implements. It is not a little significant to point out that, viewed as a class, Neolithic implements are actually ruder than Palæoliths—the proportion of polished or ground implements to those showing only rough workmanship is infinitesimal. I am aware that the museums do not illustrate this condition of things, but it is an old grievance of the man in the field that on this point the museums are misleading.

Might I suggest that the blocks of Figs. 2 and 3 in Mr. Lydekker's paper appear to be wrongly placed?

Yours faithfully,
J. Russell Larkby.

Bromley, Kent.

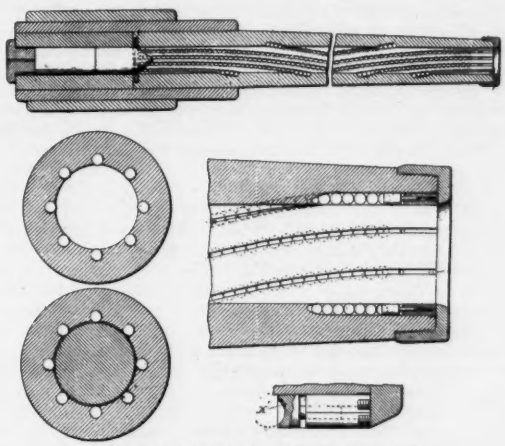
A Ball-Bearing Rifled Gun.

In spite of the improvements of modern firearms, the device by which rotation is imparted to the projectile as it leaves the gun-bore has remained stereotyped. Yet a brief consideration of the method of "rifling" which imparts the rotatory motion will show that it must interfere with one of the fundamental aims of the gun designer, which is to get his projectile out of the gun with the greatest velocity possible. The projectile, in order that it may be susceptible of receiving rotatory motion, is provided with a band of metal into which the edges of the rifled groove have to force their way. Consequently a large portion of the energy developed by the charge is dissipated in heat in the gun barrel. An American inventor, Mr. Orlan C. Cullen, has devised a method, quite simple, and to all appearance practicable, of avoiding this waste of energy.

He uses a cylindrical projectile of perfectly smooth, hard steel, travelling upon the smooth and almost frictionless path afforded by hard steel ball bearings. In the barrel a number of grooves, usually eight, are cut of completely circular section, except that a small arc is cut off so that each communicates with the bore by a narrow slot. Into these grooves are fitted steel balls, which project through the slots to the extent of about one-twentieth of their diameter, with the result that the projectile travels upon a rolling bed which offers the least possible resistance to both its forward and its rotatory motions. At first sight it might be supposed that the arrangement would not be gas-tight. That, however, is not the case; the projectile is made to fit closely to the balls, and its elasticity, combined with that of the walls of the grooves and of the balls, insures that the gas does not escape past the bullet, which, moreover, may be imagined as moving so easily and so rapidly that the gas has scarcely time to get ahead of it.

The races, or grooves, in which the balls revolve at the breech end extend back to the powder chamber, the projectile lying so that its head just engages with the first ball in each groove. At the muzzle end the grooves are closed with what the inventor terms recoil-cushions, the twist of the grooves ceasing for a short distance from the muzzle in order to admit of their insertion. These cushions are constructed either with glycerine or with steel springs, but, whichever device is used, matters are so arranged that the compression transmitted along each row of balls begins as soon as the projectile enters the bore and is complete as it leaves the muzzle. In this way the inventor claims that recoil is done away with; the bullet has a course so open and free from resistance that the initial recoil is very small, and what there is is taken up by the recoil cushions, the tendency of the bullet being rather to drag the gun after it than to kick it away behind it.

In regard to performance, the inventor states that he gets 40 per cent. greater average velocity, penetration, and range than can be obtained with the same weight of projectile and



Sections showing Rifling and Ball Bearings.

charge in guns made on the old system. His ·303 gun has a muzzle velocity of 3200 foot-seconds, and a point-blank range of 650 yards, compared with the 480 of the British service rifle of the same bore, using exactly the same charge, and, while the latter can drive its bullet through 72 one-inch boards, the Cullen gun can penetrate 116. The Cullen gun of the same calibre is 6 ins. or 7 ins. shorter, though its weight is about the same, because the barrel is thicker, and its rifling makes four complete turns, against three in the Lee-Enfield. The balls used in the grooves of a rifle of this calibre are one-tenth of an inch in diameter; in a 4-in gun they are three-quarters of an inch.

Another advantage claimed for the gun, due to the comparative absence of friction between the bullet and the ball bearings, is that the barrel does not heat; so markedly is this the case that with Maxim guns it is said to be possible to dispense with the cooling jackets which have given so much trouble in Tibet. The absence of recoil (which, however, can be obtained by contracting the bore, if it is wanted for any reason, as for working the Maxim-firing mechanism) again has important consequences, since it does away with the necessity for complicated carriages and mountings intended to take up the recoil. Mr. Cullen has a six-pounder which he fires regularly with no more elaborate mounting than a block of wood, and he claims that his guns, except when they are so heavy as to require mechanical appliances for training, could quite well be used with the antique gun-carriages which now serve no more useful purpose than to afford a picturesque decoration to some of our public places. Ships, too, should no longer need to have their structures specially strengthened in order to withstand the strains set up by the firing of their ordnance.

XUM

REVIEWS OF BOOKS.

Radio-Activity.—Three books have recently been published on radio-activity and the properties of radium; and of these three, that written with the title of "Radio-Activity," by Professor Rutherford, D.Sc., F.R.S. (Cambridge: University Press), may be taken as the standard work on the subject. To Professor Rutherford more than to any other one person is to be ascribed the proof of the disintegration theory of radium; and the demonstration that the rays and the emanations which are characteristic of radio-active substances are merely symptoms of the decay of the elements. We use the word "proof," though the proof is far from complete, and the inferences which Professor Rutherford draws from the properties of the α, β, and γ rays of radium, or from the conversion of the gaseous emanation of radium into helium, are still disputed by many chemists. If the inferences which Professor Rutherford draws are the right ones, then we should expect nearly all substances to be more or less radio-active. Professor J. J. Thomson, at the recent meeting of the British Association, declared that, in his opinion, they were so; and though Professors Elster and Geitel, whose work in radio-activity entitles them to the most respectful hearing, did not accept all Professor Thomson's conclusions, it is hard to see how they are to be refuted. As Sir Oliver Lodge has remarked, if we accept the electric theory of matter, then one might almost say that there is no need to *prove* the radio-activity of ordinary matter, for the burden of proof should rather lie on the shoulders of opponents of this view, who must show that it is *not*. If we are then to take the most generally-accepted view of the reasons for the phenomena of radium, a view which is now accepted by one of the greatest of the earlier sceptics, Lord Kelvin, we must allow the views put forward in Professor Rutherford's "Radio-Activity" to be the only ones that can endure the test of examination. They are, in a nutshell, that all the phenomena of radium are caused by the splitting up of the atoms of which radium is composed, and their dispersal as electrons, or as new combinations of electrons. The alternative view that there was something in the constitution of radium's molecules or atoms which enabled it to draw supplies of energy from the surrounding ether, or from some other unknown sources of energy, has been declared by Sir William Ramsay to be supererogatory. Among the special features of the book are the historical treatment of the discovery of the various phenomena of radium: The heat emission (MM. Curie and Laborde); the β rays; Sir William and Lady Huggins's spectroscopic researches; a discussion of the possible origin of polonium; and a full account of the results obtained by Sir William Ramsay and Mr. Soddy in the production of radium emanation from helium.

Mr. Soddy's book, "Radio-Activity" (the "Electrician" Publishing Company), bears to Professor Rutherford's larger work much the same relation that Puckle's "Conic Sections," which was sometimes called Puckle's "Salmon," bore to Dr. Salmon's classic volume. This, however, is hardly fair to Mr. Frederick Soddy, who is an investigator of great brilliance and a writer of uncommon clearness, modesty, and perspicuity. He describes in the most admirable way the experiments in which he has been associated both with Rutherford and Ramsay, and his book, while not as exhaustive as that of his former colleague, puts in a concise form the speculations and conclusions to which the experiments gave rise. There is at the end of his book a chapter called "Anticipations," which in its title, if not in its subject matter, is perhaps a little rash, but, as Professor Horace Lamb has said, "even in mathematics something must be risked," and Mr. Soddy's speculations on the vistas of theory opened to our eyes by radium are interesting to the point of enthralment.

The third book which we have to include under this notice is "Radium," by Leonard A. Levy and Herbert J. Willis (Percival Marshall and Co.); but in so including it we are bound to confess that we do it something more than justice. It is not a text-book, nor yet is it quite a popular work in the style of "Radium-and-all-about-it," but is something between the two. To those who wish to get a general view of radium's properties, sufficiently accurate, and not at all heavy in composition, we may recommend it as a preparation for more substantial works.

The History of Painting in Italy.—The full title of Crowe and Cavalcasselle's incomparable work, the first two volumes of which have just been re-published by Mr. John Murray, and the remaining four of which, edited by Langton Douglas and the late Arthur Strong, are to follow in due course, runs "A History of Painting in Italy, Umbria, Florence, and Siena, from the Second to the Sixteenth Century." But the substitution of one substantive for another is justified by the fact that the history which Sir Joseph Crowe was assisted by Signor Cavalcasselle to compile, remains now, as it was then, distinctively and unalterably *the* history of the evolution of the painter's art in Italy. As Mr. Langton Douglas incontrovertibly remarks, notwithstanding all that has been done in the last forty years, by archivists on the one hand, and by connoisseurs on the other, with the object of elucidating the history of the central Italian Schools, this book continues to be the standard authority upon the subject. It is in one sense more than that. It is one of the few books of scientifically accumulated facts, of which it might be said that an English work is the admitted European authority. In the collection of "co-efficients" on which to base theories the Germans are apt to beat us. This work has all the laboriousness of German effort without any of the repellent appearance of it; it is, in short, a work of art as well as a monument of human learning. It is encumbered with few of those theories which are accounted precious in one generation only to be forgotten in the next; but to the student who considers art from the point of view of its evolution, it presents all the raw materials for theory. If ever there should arise some Darwin among the historians of painting—which perhaps the painters might pray heaven to forbid—he would find no other work than this by which he might trace the gradual evolution of a style or a method; the tendency to variability could be illustrated from these pages; the mutations arising from the accident of genius could be dated and their influence assigned. This is, however, to let one's imagination run away with one to an extent that would have been severely discountenanced by the authors, whose practice it was to admit no fact that had not borne the test of the severest scientific questioning; and we may fitly conclude this notice of a famous book by the statement of the necessary facts concerning the new edition. The original edition, now quite out of print, and very rarely to be bought, and only at a great price, was enriched with few illustrations. Its unique exactness and comprehensiveness was its sufficing recommendation. The new volumes are illustrated with all the resources of modern photography. Sir Joseph Crowe's additions to the first four volumes, amounting almost to re-writing, have been incorporated; and to the original text most valuable notes by Mr. Langton Douglas and Mr. Strong have been added in smaller type. The first two volumes are "Early Christian Art" and "Giotto and the Giottesques." The Sienese School, the Florentines of the Quattrocento and Cinquecento and the later Sienese and Umbrians will follow.

The Classification of Flowering Plants.—Dr. Albert Rendle's task in the latest volume of the Cambridge Biological Series, "The Classification of Flowering Plants" (Cambridge University Press), is to present to the student the considered results in classification which are afforded by the latest research in systematic botany. This, the first volume, deals with the Gymnosperms, pines, cedars, spruces, &c., and with the Monocotyledons, the lilies, grasses, and palms. The Dicotyledons will appear in the second volume. Historically, the general introduction is of the greatest interest, for here is to be found a clear comparative summary of the successive schemes in which Linnæus, Jussieu, and the De Candolles sought to express the resemblances and relationships of the flowering plants, Dr. Rendle has done something more than present summaries of these classifications; his method of presenting them is an essay in comparative criticism. In the rest of the book Dr. Rendle adheres to the most generally-accepted models of classification. That of the Gymnosperms includes the latest palæontological discoveries of Drs. D. H. Scott and Oliver. In discussing the Monocotyledons, the arrangement of Dr. Engler is the one to which he adheres. There may be some difference of opinion in respect of the nomenclature adopted in the classification of the Monocotyledons; but of the value of the work as a standard text book there can be but one opinion. It is extremely well illustrated.

XUM

British Mosses.—The declared object of the first edition of "The Student's Handbook of British Mosses," by H. N. Dixon and H. G. Jameson (Sumfield, Eastbourne; Wheldon, London), was to provide a practical handbook to the mosses of these islands in such a form as to be accessible to students; and we are pleased indeed to see that after eight years this modestly-stated ambition has been rewarded by the call for a second edition. It is a reward far from immodest for a book which is in the highest degree useful, not to say indispensable, to the student; and which is compiled with a wealth of care such as perhaps would be taken by no one but the painstaking race of botanists for whom the consciousness that genius is the capacity for taking small pains must be a frequent, and, we hope, a not altogether barren consolation. Since the publication of the first edition some thirty species or sub-species have been added, together with a corresponding number of varieties of greater or less value. Recent research has added more precise knowledge of older varieties and has sometimes made changes in nomenclature necessary. It has not been possible to interpolate these additions to knowledge bodily in the volume without some alteration in its arrangement; but the changes that have been made in a classification, with which the authors had every reason to be satisfied, have been made with extreme care. The authors believe that such as are made will be found to be improvements, a belief which criticism may endorse.

Electro Chemistry.—To the series of text books on Physical Chemistry (Longmans, Green) to which Sir William Ramsay wrote the general introduction, Dr. Lehfeldt has contributed the volume on "Electro Chemistry." This volume deals with the theoretical side of the subject only; the application of the theory to the practical consideration of primary and secondary cells, to electrolysis, and to the solution of chemical problems is to follow. The relation between quantity of electricity and quantity of chemical action is elucidated in a chapter ranging from the consideration of Faraday's laws of electrolytic deposition to the Arrhenius theory of dissociation and its corollaries in respect of the conductivity of mixtures. The relation between electric intensity and the intensity of chemical action follows as a sequence to the first, and considers the theories of concentration, polarisation, &c., under the comprehensive heading of the theory of chemi-electromotive force. A chapter which the preface obligingly states can be missed by those who are not interested in pure chemistry, but which will probably not be missed by anyone who desires to keep in touch with the modern theories of chemical solution, is interpolated by Mr. C. S. Moore, on the relation of Chemical Constitution to Conductivity. The concentration of information in the text book is not its least noticeable feature.

Kinetic Theory.—In "Applications of the Kinetic Theory" (Macmillan), Professor W. P. Boynton endeavours to present the probable or possible relations to one another of the facts of electrolysis, of osmotic pressure, and the general phenomena of dissociation and solution, as seen by the light of the kinetic theory. In successive chapters, the kinetic aspect of ideal gases, of gases with molecules that have dimensions, of the conduction of electricity and heat; of vaporisation; of the behaviour of molecules within a liquid; of solutions; of dissociation and condensation, are dealt with. The volume is one of great suggestiveness to advanced students of physical chemistry, and though the author disclaims any originality of treatment, he displays judicial and selective powers of analysis and arrangement of the highest order.

Visceral Inflammations.—It has been said that there is a fashion in diseases; and in this casual observation there is the grain of truth that increased knowledge implies more precise classification of diseases ascribed loosely to causes and symptoms which may be merely incidental. Thus, as we are reminded by the papers and addresses which Dr. David B. Lees has collected in "The Treatment of Some Acute Visceral Inflammations" (John Murray), the knowledge which in the last twenty years has been gained of pneumonia, appendicitis, rheumatism, and the acute inflammations of the heart and kidneys, has resulted in an apparent increase of the number of cases classified under these heads. As an instance of what we mean, we may quote the cases of appendicitis, which for generations past have been ascribed to varying causes, many of them totally unfounded, but which are now grouped under the primary cause of an acute local inflammation. Similarly, the increase of knowledge in bacteriology has transformed the view taken of diseases such as pneumonia, and is throwing new light on many rheumatic affections. But the advance of treatment of these diseases has not kept pace with the advance of knowledge of their causes; and the treatises of those who, like Dr. Lees, have employed sixteen years of hospital work in the practical consideration of them, have the highest value, and are of the highest interest inside and outside the medical profession alike. It is, of course, as a text-book of medical treatment that such a volume is compiled; but we have no hesitation in according it notice in columns which are chiefly intended for the review of general scientific literature. Its chief contents are lectures on carditis, pneumonia, empyema, pleurisy, appendicitis, and nephritis, with other papers on heart affections, their connection with rheumatism, especially in children; and some of the heart symptoms which follow influenza.

Common Animals.—Among the many good points of "The Natural History of some Common Animals," by Oswald H. Latter, M.A. (Cambridge University Press), is the extremely natural and logical way in which it teaches elementary zoology. Mr. Latter would divorce from elementary teaching of this subject the notion that structure must occupy the first, and almost the only, place in any method of study; and would impress on the minds of the instructed the necessity for learning function as well. In this way, as we believe, lies the best chance and opportunity of impressing on the mind of the young student a liking for the subject; and in impressing on his memory the relatively important details. Mr. Latter has thus chosen a few animal types as the best to suit his purpose, and has taught something about everything concerning them. The types selected are the Earthworm, Leech, Crayfish, Cockroach, Dragonfly, Wasp, Fresh-water Mussel, Snail, Slug, Frog, Toad and Newt, and some of the common internal parasites of domestic animals, and of these he has given a full biological and bionomical narrative. Of its kind this book is one of the best that has yet been written; its manner and matter are alike excellent.

Practical Geometry.—The "Practical Geometry for Beginners" (Macmillan and Co.), which has been compiled by W. L. Neve Foster and F. W. Dobbs, is based on the sound logic that the best way of preparing the youthful mind for theory is to suggest to it concrete values of lines, angles, perpendiculars, radii, and all the other furniture of geometry. Thus the book teaches geometry with the box of mathematical instruments, and a triangle no longer remains a symbol A B C or D E F, but is something tangible, measureable, comparable. This is but a hint of the method which eventually proceeds to the practical verification of theorems and laws, and which may be commended as practically useful and educationally interesting.

Technical Thermometry.—The Cambridge Scientific Instrument Company sends us a copy of their list on "Technical Thermometry," together with an intimation that the lists can be obtained from them, on application, by readers of "Knowledge." The list is a summary of the latest methods and appliances in electric thermometry; and, apart from its use to students, it is of instructional value in defining the practical applications of electrical thermometers in annealing furnaces, in boilers and superheaters, and in explosive sheds. The thermometer, and, above all, the exactly and instantaneously recording thermometer, has become, in recent years, of the utmost importance to chemical works, to the brewing industry, and to engineers and manufacturers in increasing numbers. The catalogue before us is a summary in brief of the instrument's use and practice.

The new catalogue of Messrs. Isenthal and Co.'s Electric Heating Apparatus forms a not uninteresting record of the various uses to which any householder can turn the electric current supplied to him from the mains. For readers of "Knowledge" the list is chiefly of service in detailing the uses to which electric heating apparatus can be put in the laboratory or the hospital, but the limits to the purposes to which electricity can be applied in the dwelling-house, the kitchen, the workshop, and the factory are becoming enlarged every day.

XUM

MICROSCOPY

Conducted by F. Shillington Scales, F.R.M.S.

Coccidae.

With Notes on Collecting and Preserving.

By Alice L. Embleton, B.Sc.

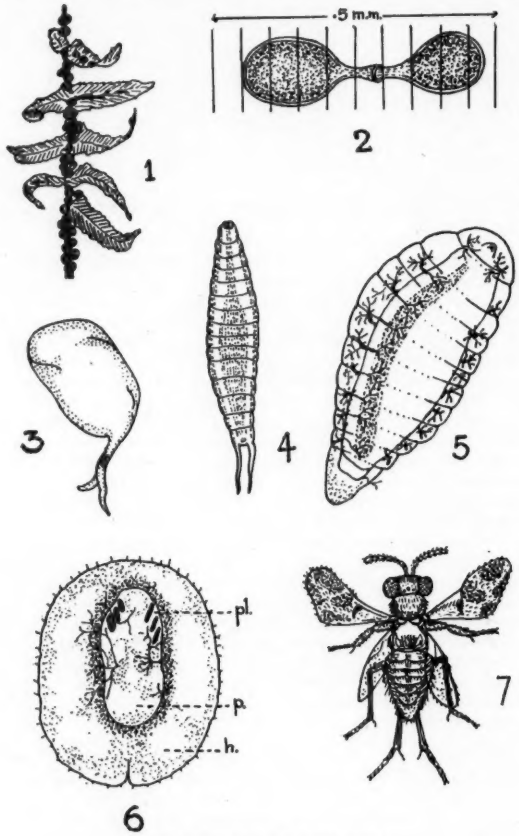
(*Continued from page* 224.)

As regards the possible introduction of the San José into Europe, there is little cause for alarm, for the climatic conditions and the character of fruit-growing in this continent would make it hard for this scale ever to become a serious factor here.

In the West Indies enormous damage is done to crops of all kinds, and yet it is only within the last decade of the 19th century that attention has been paid to scientific work on economic entomology. The sugar-cane pests in particular are responsible for a heavy, regular loss to the planters; investigations are now, however, being carried on with a view to finding remedies and controlling methods.

It is best to begin with measures of quarantine against the introduction of new diseases. Preventive measures ought to be adopted, for it is of enormous importance if an outbreak of a disease can be avoided, and it is only by a knowledge of the life-histories of the pests that an attack can be predicted and controlling conditions set up, such as, for example, alternation of crops and trap-crops. If, however, the insect is already established, then suitable remedial measures must be applied, either by the direct use of poisons, or by the indirect control through the presence of enemies to the injurious insect. Fortunately for the horticulturist, *Coccidae* have innumerable enemies, and the problem of their control is largely solved by the action of checks provided by Nature, such as birds, lizards, bats, etc. Apart from these there are the multitudes of insects that prey upon *Coccidae*, either as predators or parasites; these tend, in a state of nature, to keep the balance right, but this equilibrium becomes much upset by the artificial conditions set up in cultivated countries where it is impossible to avoid this disturbance of the influence of natural checks.

The *Coccidae* are hosts for numerous minute insect parasites, as well as being food for the predaceous ladybird beetles (*Coccinellidae*), which are among their most important natural enemies. Among the many thousands of minute Hymenopterous insects in the world to which have been given the popular name of "Chalcid flies," there is probably no single family that is of more interest and importance from an economic point of view than that of the *Encyrtidae*. The various species composing this family, like the vast majority of Chalcid flies, live parasitically in the eggs, larvæ, pupæ, and imagoes of other insects, and hardly a single order of six-legged insects is wholly free from their attacks. But in this family, and more especially in the sub-family *Encyrtinae*, the species are of more particular interest and importance for the economist, since so many of them are found attacking and destroying *Coccidae*. The work on the development and life-histories of these small creatures is of necessity very minute, seeing that the hosts are usually only one or two millimetres in length in the adult condition; and yet little can be done in the matter of encouraging these beneficial creatures unless their life-cycles are well known. Much of the work demands special methods for the microscopic preparations. To illustrate this we may take the well-known brown scale on ferns and



EXPLANATION OF FIGURES.

Fig. 1.—Portion of Fern-frond attacked by *Lecanium hemisphaericum* **var.** *filicum*, **the Coccid being parasitised by** *Comys infelix*.

Fig. 2.—Egg before separation of the two masses.

Fig. 3.—Egg after losing the yolk-mass.

Fig. 4.—First observed larva with bifurcated tail. Length, ·75 mm.

Fig. 5.—Larva showing spiracles.

Fig. 6.—Prepupa in situ in the host, inverted position. *h*=**host;** *p*=**parasite;** *pl*=**plates.**

Fig. 7.—*Comys infelix*. ♀, **dorsal view. Length, 2·5 mm.**

Drawn by F. Shillington Scales after drawings by Miss A. L. Embleton.

palms (*Lecanium hemisphaericum*), which is parasitised to an enormous extent by a minute Encyrtid (*Comys infelix*). On a fern frond that has, say, 200 *Coccidae* upon it, at least 190 of these will be killed by the *Comys*. The female of this little fly measures 2.5 mm. in length, and is black, with fuscous patches on its wings. It is very curious that the male is extremely rare, for whereas the females occur in myriads, the males have only once or twice been obtained. In many ways the life-history of this fly, as far as at present known, is extraordinary and unique. The newly-

hatched female is found to have ovarian tubes in which are eggs in various stages of development. The youngest appear as oblong protoplasmic masses in the tube; later each of these masses in the chain becomes constricted in the middle; this becomes more accentuated, until the egg assumes a dumb-bell shape, the two parts being connected by a narrow neck, on which there is a curious papillated valve or lip. Before this egg is laid in the Coccid host, one division disappears, so that the egg as found in the host is an oval body with a stalk which is found to run to the surface of the host's carapace, where its mouth is plugged with some dark substance. The position of the parasite egg is constant, being always dorsal and posterior, a little to the left. In an allied form, *Encyrtus fusicollis*, Professor Marchal, of Paris, has found that each egg gives rise to upwards of a hundred embryos—the host being a caterpillar.

The larvæ of *Comys infelix* passes through various curious and complex conditions, peculiar chiefly for the means it adopts for breathing; the most startling being that of the prepupa, where the host tracheæ appear to be themselves utilised and connected with the parasite spiracles, and respiration goes on with the aid of these borrowed tubes. Another curious feature is that the prepupa seems to evolve a modification of the Malpighian tubules of the larval form, and to get rid of its spare uric acid in sacs containing rosettes of red uric acid crystals, these sacs being applied to the sides of the parasite's body, and left behind on the old pupal skin when the fly escapes.

(*To be concluded.*)

Newton's Rings in Microscopical Objectives.

A Correspondent sends the following note:—

"The modern method of testing optical curves on glass to ascertain that they are accurately formed is by means of what is known as proof plates. These proof plates are made of glass, having ground and polished in them the precise curve required. When the lens is finished, the proof plate is put in contact with it, and if the two are coincident—*i.e.*, the two surfaces of the lens and the proof plate respectively make optical contact—coloured rings, known as Newton's Rings, will be seen.

"For immersion objectives used on the microscope, the full power of the objective can only be developed when specimens are mounted either in a medium of suitable refractive index, or are actually adherent, and in optical contact with the under side of the cover glass. If a slide of the diatom Pleurosigma angulatum be searched over with a lens, say, of ½-in. power and a deep eyepiece, specimens will be found on which coloured rings—some round, some elliptical, others of a nondescript shape—will be seen, and it is in the centres of these appearances that the frustule, or a portion of it, is in optical contact with the cover glass. Having located this position, if an oil immersion objective be used, immensely superior definition will be found to be obtained at this point of optical contact than can be secured on other parts of the diatom which may not be so close to the cover."

Cleaning Oil-Immersion Objectives.

Dr. Henri Van Heurck calls attention to the advantage of using saliva as a means of cleaning oil-immersion lenses. He first cleanses the objective and slide with a piece of old dry linen of fine texture, then moistens an end of the linen with a little saliva, and gently rubs the objective front with it, using a magnifier to see if the cleaning is perfect. Owing to the slightly alkaline nature of the saliva the cleaning is perfect, and practically instantaneous; and Dr. Van Heurck says he has used this method since 1878, and has never found it to fail, whilst it keeps the front of his objectives as clear as when new.

Popular Microscopical Lectures.

I have received the annual list of lectures proposed by the Extension Section of the Manchester Microscopical Society for the ensuing winter. The scheme is so admirable and so well arranged that it deserves more than a mere reference. Briefly, some 54 different lectures, selected from the infinite variety of subjects dealt with by the microscope and illustrated mostly by lantern slides, are arranged to be given by some 20 members of the foregoing Society. They are given to outside associations of all kinds who make the necessary application, and, except in cases where such associations are supported out of public funds or are commercial speculations, are given free of charge other than the reimbursement of actual out-of-pocket expenses. The result is the bringing of scientific knowledge and information before those who would be unable to pay large fees to professional lecturers, and the extension of the knowledge of microscopy and natural history. Nowadays the microscope, whilst becoming daily more and more necessary to the professional, finds many competitors for favour with the amateur, and lectures of the kind arranged by the Manchester Microscopical Society should bring home to many the fascination of the microscope as a recreative as well as educational instrument. It would be well if the Quekett Club could see its way to adopt a similar scheme; in so large a district as is embraced by the Metropolis there should be no lack of applicants for the services of its lecturers, and the result could not fail to be of benefit to microscopy, and, incidentally, to the Club itself.

Notes and Queries.

Wm. Watts, Bristol.

Total length, ·055 to ·06 mm. Head, ·0045 mm. long, ·0025 mm. broad, ·0015 mm. thick. Middle piece or body, ·006 mm. long and less than ·001 mm. in diameter. Tail, ·045 mm. long and finer than the middle piece.

J. M. Dunbar, East Griqualand.

I am sorry that I do not know of any good book dealing with the microscopical examination of adulterated foods. Such an examination is really a matter for the specialist, and the microscopical examination would be only part of a wider examination, chemical and otherwise. If you can read German, perhaps Dr. Herman Hager's "Das Mikroskop und seine Anwendung," published in Berlin, might serve as an introduction. It could be obtained from Williams and Norgate, Covent Garden, London, for about seven shillings and postage. I wonder if any of my readers know of any other book?

Microscopical Material.

Mr. W. S. Rogers has kindly sent me for distribution a quantity of capsules of *Funaria hygrometrica*, the peristomes of which make very beautiful dry mounts, and are curious owing to the changes they undergo when wet and dry respectively. I shall be glad to send a few of these to any reader enclosing a stamped addressed envelope together with the coupon appearing in another part of this issue. In case the lids have not been shed they may be removed with a fine needle, but great care is requisite.

[*Communications and enquiries on Microscopical matters are invited, and should be addressed to F. Shillington Scales, "Jersey," St. Barnabas Road, Cambridge.*]

XUM

The Face of the Sky for October.

By W. Shackleton, F.R.A.S.

The Sun.—On the 1st the Sun rises at 6.1, and sets at 5.37; on the 31st he rises at 6.53, and sets at 4.34.

Sunspots, faculæ, and prominences are fairly numerous.

The positions of the spots, &c., with respect to the equator and poles may be derived by employing the following table :—

Date.	Axis inclined from N. point.	Centre of disc, N of Sun's equator.
Oct. 1 ..	26° 11′ E.	6° 38′
,, 11 ..	26° 29′ E.	6° 2′
,, 21 ..	26° 2′ E.	5° 15′
,, 31 ..	24° 49′ E.	4° 17′

The Moon :—

Date.	Phases.	H. M.
Oct. 2 ..	☾ Last Quarter	1 52 p.m.
,, 9 ..	● New Moon	5 25 a.m.
,, 16 ..	☽ First Quarter	5 54 a.m.
,, 24 ..	○ Full Moon	10 56 a.m.
,, 31 ..	☾ Last Quarter	11 13 p.m.
Oct. 8 ..	Perigee	6 6 a.m.
,, 20 ..	Apogee	2 6 p.m.

The only occultation of the brighter stars visible before midnight is that of 96 Aquarii, magnitude $5\frac{3}{4}$, at 7.49 p.m. on the 20th.

The Planets.—Mercury is a morning star in Virgo; he is at greatest westerly on the 1st., subtending an angle of 17°54′ W., when he rises nearly 2 hours in advance of the Sun. The planet is in superior conjunction with the Sun on the 31st.

Venus is an evening star in Libra, but is too low down in the S.W. at sunset to be suitable for observation.

Mars is a morning star in Leo, rising about 2.15 a.m. on the 15th.

Jupiter rises about sunset throughout the month, and forms a very conspicuous object in the sky, looking due E. about 7 p.m. The planet is in opposition to the Sun on the 18th, when the apparent equatorial diameter is 50″·4, whilst the polar diameter is 3″·3 smaller.

At 10 p.m. on the 23rd the planet is in proximity to the Moon, being only 1°$\frac{1}{2}$ to the North.

The configurations of the satellites, as seen in an inverting telescope at midnight, are as follows :—

Day.	West.	East.	Day.	West.	East.
1	423○1		16	1○432	
2	41○$^{2}_{3}$		17	4○$^{2}_{3}$1	
3	4○213		18	421○3	
4	42○3	●	19	42⊙3	
5	413○2		20	43○12	
6	43○12		21	4312○	
7	34$^{2}_{1}$○		22	432○1	
8	234○1		23	41○32	
9	1○3$^{2}_{4}$		24	4○123	
10	○2134		25	21○43	
11	21○34		26	2○134	
12	○4⊙$_1$⊙^{3}●$_2$		27	3○24	●
13	3○124		28	312○4	
14	312○4		29	32○14	
15	$^{2}_{3}$○14		30	1○324	
			31	○1234	

The circle (○) represents Jupiter; ⊙ signifies that the satellite is on the disc; ● signifies that the satellite is behind the disc, or in the shadow. The numbers are the numbers of the satellites.

Saturn is suitably placed for observation in the early evening, being on the meridian about 7.30 p.m. and setting at midnight on the 15th. Throughout the month the planet is nearly stationary in Cancer; he is near the Moon on the evening of the 17th.

The ring is widely open and we are looking on the northern surface at an angle of 16°; the polar diameter of the ball is 16″·2, whilst the major and minor axes of the outer ring are 40″·8 and 11″·5 respectively.

Uranus is on the meridian about 4 p.m. and sets in the S.W. about 8 p.m., near the middle of the month. He is close to the star 4 Sagittarii.

Neptune rises about midnight on the last day of the month. He is situated in the constellation Gemini, as shown on the chart in the January number. The planet is in quadrature with the Sun on the 1st, and at the stationary point on the 11th.

Meteors :—

The principal shower of meteors during the month is the Orionids.

Date.	Radiant.		Characteristics.
	R.A.	Dec.	
Oct. 8–29 (18 to 20 maximum)	92°	15° N.	Swift, streaks.

The Stars :—

About 9 p.m., at the middle of the month, the following constellations may be observed :—

Zenith . Cygnus, Cepheus, Cassiopeia.

South . Pegasus, Aquarius, Capricornus, *Fomalhaut*.

West . Lyra, Hercules, Ophiuchus, Corona; Boötes to the N.W.; Aquila to the S.W.

East . Andromeda, Perseus, Aries, Pleiades; Auriga to the N.E.; Cetus to the S.E.

North . Ursa Major, Ursa Minor, Draco.

Minima of Algol may be observed on the 2nd at 5.14 p.m., 17th at 1.19 a.m., 19th at 10.8 p.m., and 22nd at 6.57 p.m.

Telescopic Objects :—

Double Stars :—γ Arietis 1^h 48^m, N. 18° 48′, mags. 4·2, 4·4; separation 8″·8. Easy double, power 30; notable as being the first double star observed telescopically.

γ Andromedæ 1^h 58^m, N. 41°·52′, mags. 2·1, 4·9, separation 10″·2. The brighter component is intensely yellow, whilst the other is greenish blue. The fainter star is remarkable for being a binary, the components of which are now less than 1″ apart.

Nebulæ :—

Nebula in Andromeda, easily visible to the naked eye, and readily found by referring to the stars β and ν Andromedæ. Seen with a 3 or 4 inch telescope, it appears to be an extended oval, which is in reality composed of spiral streams of nebulous matter.

(32 M.) Nebula close to the great Andromeda nebula, and situated about 2° to the south. It is fairly round, and appears somewhat like a star out of focus.

(18 $\frac{H}{5}$ v) lies about the same distance north of the great Andromeda nebula that 32 M does south; it is faint, but large and elliptical.